TECHNOLOGY DEPT.

TECHNOLOGY REVIEW

April 1957

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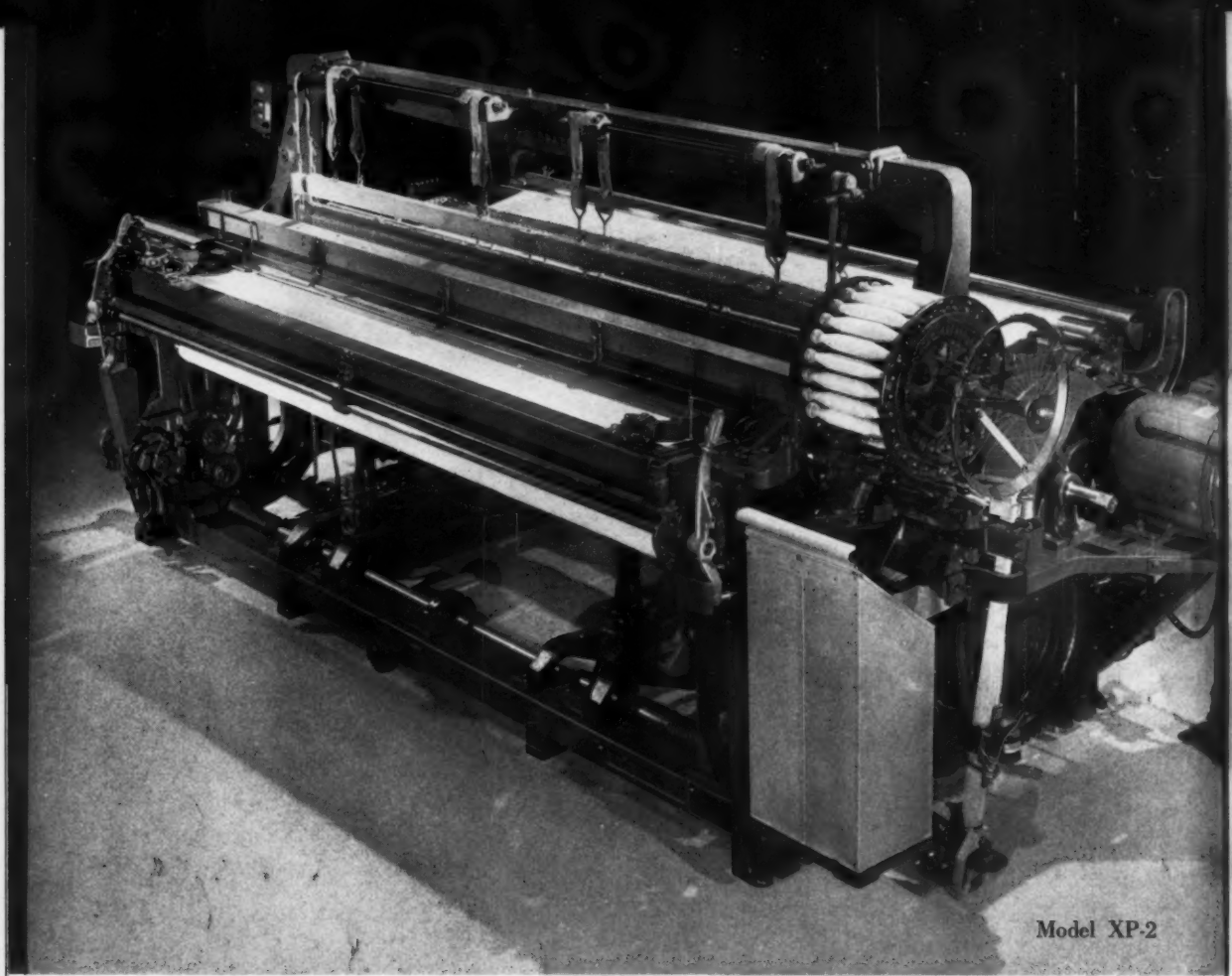

Model XP-2

Increase Wide Sheeting Production . . . with the new XP-2

New constructions found necessary for higher speeds in other models are now available *for the first time* in a wide sheeting loom.

The Draper XP-2 is equipped with a conventional type Pick Motion, simplified Power Transmitter, Bartlett Let-Off, Worm Take-Up, Easy Shipper and Positive Brake.

These adaptations mean increased production, greater loom versatility, less downtime and easier loom operation.

Engineered for high speed and efficient performance the Draper XP-2 *offers better profit margins.*

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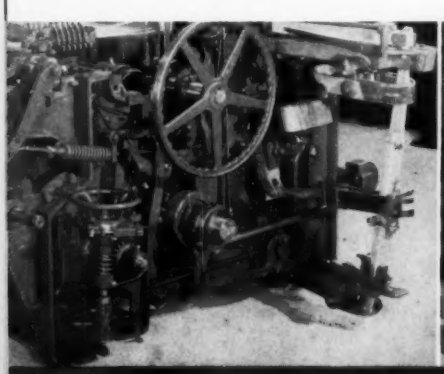
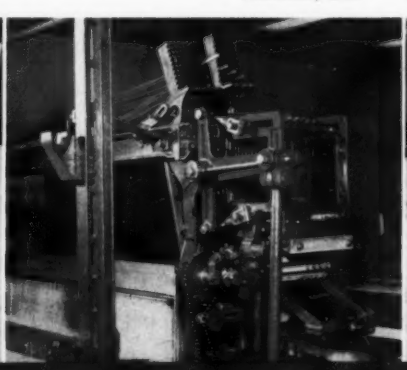
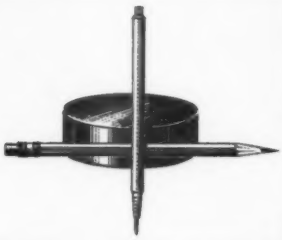
Atlanta, Ga. *Greensboro, N. C.* *Spartanburg, S. C.*





. . combs or cosmetics



. . . pencils or pucks

. . . inks or insecticides

Better Products begin with CABOT!

Cabot raw materials for industry — still increasing and constantly being improved by continuing Cabot research — have been putting a plus into other people's products for 75 years.

Better rubber and plastics products . . . better paints and pharmaceuticals . . . better inks and insecticides . . . the list of products made better by Cabot raw materials is long — and still growing.

It costs you nothing to find out whether or not Cabot can help you with your raw material problems — and it may well result in a product that performs better, lasts longer, earns more profit. It's happened before with hundreds of manufacturers who have proved to themselves that better products begin with Cabot.

CABOT

WHICH OF THESE CABOT MATERIALS CAN HELP YOUR PRODUCT?

CABOT CARBON BLACKS . . . *more than 45 different grades of channel, furnace and thermal blacks for use by the rubber, printing ink, paint, varnish, lacquer, enamel, plastics, paper, phonograph record, battery and other industries.*

WOLLASTONITE . . . *as a paint pigment, this white, uniform calcium metasilicate, has more desirable properties than other extenders used singly or in combination. Excellent for ALL types of paint, and for the quality improvement of wall tile and semi-vitreous ceramics.*

CAB-O-SIL® . . . *this unique colloidal silica, in extremely small quantities, greatly improves large numbers of products. The best flow control agent available, it's especially remarkable for its unusual combination of properties. Used for rubber, paint, varnish, printing ink, plastics, lubricants, cosmetics, many other products.*

CABFLEX®PLASTICS CHEMICALS . . . *a complete range of plasticizers developed for the specific improvement of rubber and vinyl plastic products.*

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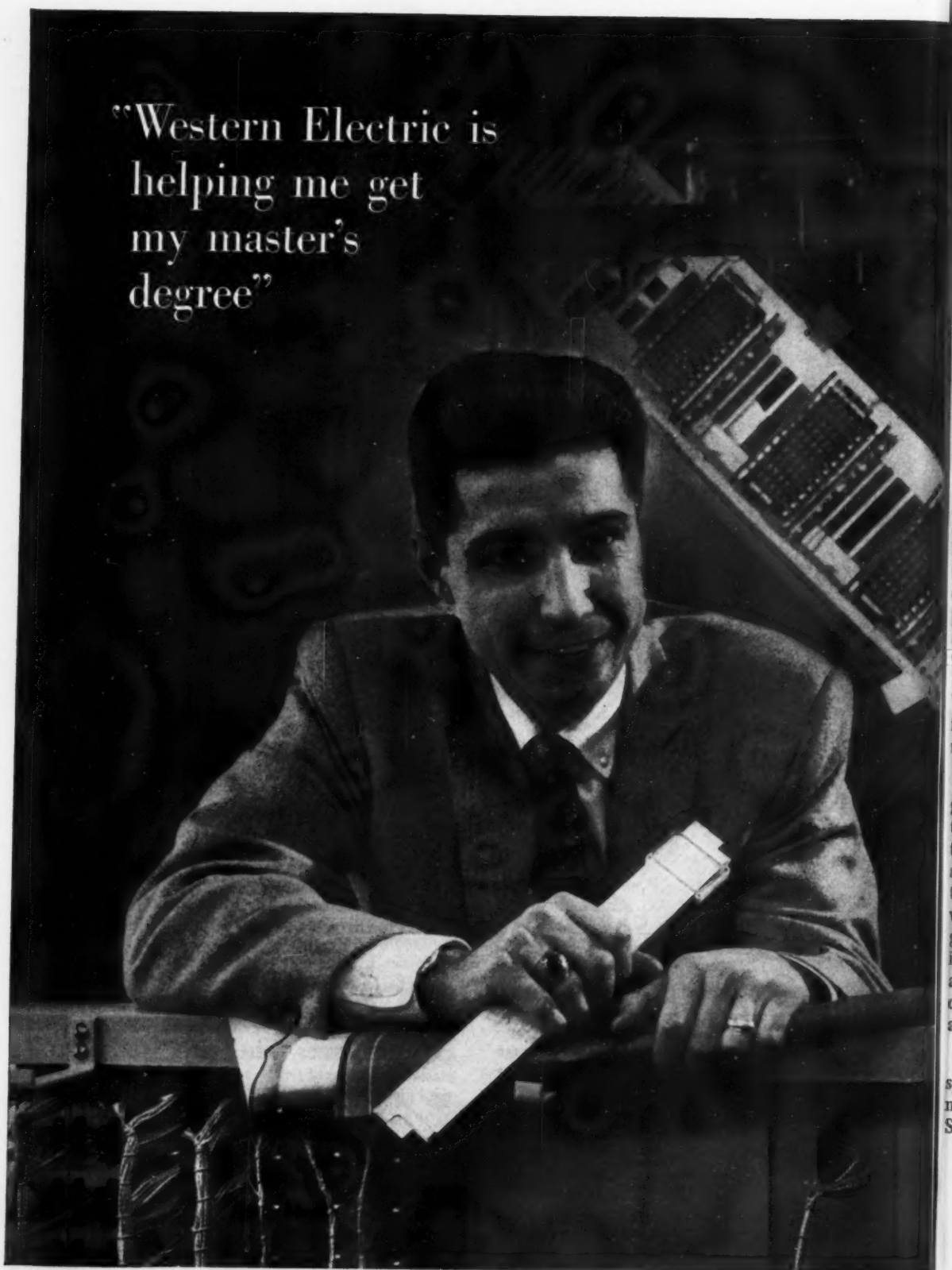
For complete information, phone or write:

GODFREY L. CABOT, INC.

77 FRANKLIN ST., BOSTON 10, MASSACHUSETTS

Phone: LIberty 2-7300

THE TECHNOLOGY REVIEW, April, 1957, Vol. LIX. No. 6. Published monthly from November to July inclusive at Emmett Street, Bristol, Conn. Publication date: twentv-seventh of the month preceding date of issue. Annual subscription $4.00; Canadian and Foreign subscription, $4.50. Entered as second-class matter December 23, 1949, at the Post Office, at Bristol, Conn., under the Act of March 3, 1879.



JOHN MORAN, who joined Western Electric's engineering staff at the Kearny Works recently, is now studying for his M.S.M.E. under the ne Tuition Refund Plan. Western Electric expects to refund the tuition for John's graduate study at the Newark College of Engineering this yea

Western Electric's new TUITION REFUND PLAN can help you continue your studies while launching an exciting career

Under the new plan, Western Electric will refund tuition costs for after-hours study at graduate or undergraduate level, up to a maximum of $250 for each school year.

Say, for example, that you decide on a career at Western Electric in one of many rewarding phases of telephony—electronics, development engineering, design, manufacturing production, plant engineering, or some other. You may be eligible for financial assistance to help defray the cost of graduate or other study from the very first day. Choose engineering, science or any course that is appropriate to your job or that adds to your ability to accept greater responsibility, and the Company will refund to you up to $250 a year for tuition. (You'll note from the map on this page that Western Electric's work locations are well situated in terms of major population areas. That means that many of the nation's best schools are close by.)

Plus values, like the new Tuition Refund Plan, give Western Electric engineers many opportunities that others never have. There's specialized training both in the classroom and on the job . . . a formal program of advanced engineering study that includes full-time, off-job courses of up to 10 weeks' duration . . . a retirement and benefit program that's one of the best known and most liberal in industry . . . low-cost life insurance that would appeal to any man with his eye on the future. And of paramount importance is the chance to work alongside top men in the field of communications.

There's a good deal more for which there isn't space here. Why not write us or contact your placement office to schedule an interview when Bell System representatives visit your campus.

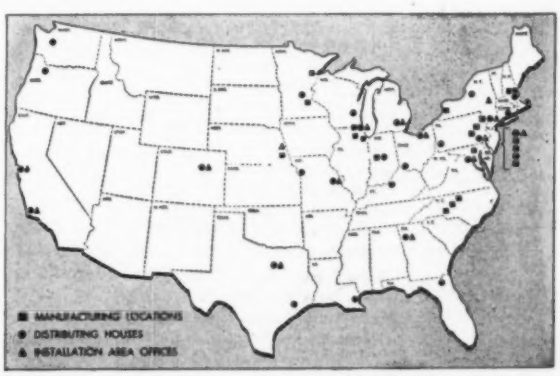
As one of us, you'd help engineer the manufacture, distribution or installation of the equipment needed for the nation-wide communications network of 49 million Bell telephones.

Here—where transistors were first developed for production; where repeaters for the new transatlantic telephone cable were tailor-made—there's a constant need for new products and new processes. Two-thirds of the equipment we make today for the Bell telephone companies is of types developed since World War II.

Besides telephone work, Western Electric—over the years – has been responsible for a continuous flow of defense jobs for the government such as the Nike guided missile system and the DEW Line.

There's plenty of room for advancement . . . whatever your field of specialization. So—whether you'd be helping with our telephone job, or working on a major defense project like guided missile systems—with Western Electric you can expect to grow!

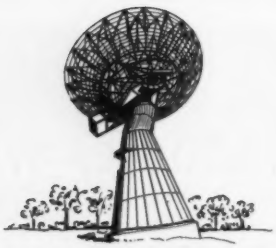
For our College Tuition Refund Plan booklet and additional information about Western Electric write: College Relations, Room 1034, Western Electric Company, 195 Broadway, New York 7, N. Y.



Western Electric has major manufacturing plants located at Chicago, Ill., Kearny, N. J., Baltimore, Md., Indianapolis, Ind., Allentown, Pa., Winston-Salem, N. C., Buffalo, N. Y., North Andover, Mass. Distribution Centers in 30 cities. Installation headquarters in 16 cities. General headquarters: 195 Broadway, New York, N.Y. Also Teletype Corporation, Chicago 14, Illinois.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM



HYCON FILTER APPLICATIONS ARE MANY . . .

Whether tracking signals from outer space or dispatching a fleet of radio equipped taxicabs, Hycon Filters are finding wide application in many of today's advanced receiver installations. Listed herewith are a number of users of Hycon Filters. It will pay you to investigate how Hycon Filters can help solve your selectivity problems.

A C The Electronics Division
General Motors Corporation
Air Force Cambridge Research Center
Allen B. DuMont Laboratories, Inc.
American Radio Relay League
Applied Physics Laboratory
The Johns Hopkins University
Bell Telephone Laboratories, Inc.
Canadian Marconi Company
Collins Radio Company
Crosley Division
Avco Manufacturing Corporation
Ewen Knight Corporation
Fada Radio & Electric Co., Inc.
Federal Telecommunication Labs.
General Electric Company
General Precision Laboratory, Inc.
Gilfillan Brothers, Inc.
Hughes Aircraft Company
Kahn Research Laboratories
Laboratory For Electronics, Inc.
Laboratory Procurement Office
The Army Signal Supply Agency
Lear, Inc.
Massachusetts Institute of Technology
Lincoln Laboratory
Motorola, Inc.
National Bureau of Standards
National Company, Inc.
Naval Research Laboratory
Philco Corporation
Pye Ltd. . . . Cambridge, England
Radio Corporation of America
Radio Engineering Laboratories, Inc.
The Ramo-Wooldridge Corporation
Raytheon Manufacturing Company
Siemens New York Incorporated
Stromberg-Carlson Company
Sylvania Electric Products Company
University of Colorado
Westinghouse Electric Corporation
Wilcox Electric Company, Inc.

HYCON EASTERN, INC.
75 Cambridge Pkwy., Cambridge 42, Mass.

Affiliated with HYCON MFG. CO., Pasadena, Calif.

THE TABULAR VIEW

Look at Communism. — After almost four decades of planning and rigid control, recent events in Russia, and especially in Hungary and Poland, strikingly reveal the success of communistic "peoples democracy." At the M.I.T. Mid-America Conference in Chicago, ALLEN W. DULLES discussed "Evolution in the Communist World" which The Review is pleased to bring to a larger audience (page 295). After receiving the B.A. and M.A. degrees from Princeton University in 1914 and 1916, Mr. Dulles served with distinction for a decade in the diplomatic service of the United States. He was a member of the American Commission to negotiate peace at the Paris Peace Conference, 1918–1919, a U.S. delegate to the International Conference on Arms Traffic in Geneva in 1925, a delegate to the Preparatory Disarmament Conference of 1926, and legal adviser to the American delegation of the General Disarmament Conference in Geneva, 1932–1933. He served with the Office of Strategic Services in Switzerland in World War II, and later became head of the O.S.S. mission to Germany. Currently, he is director of the Central Intelligence Agency.

Technology Shapes Future. — In February, PRESIDENT JAMES R. KILLIAN, JR., '26, spoke at the Institute's two Regional Conferences held in Tulsa and Chicago. Dr. Killian's scholarly address at Tulsa (page 299) emphasizes the positive contributions which technology makes to our way of life. At last count, Dr. Killian held degrees from M.I.T., Middlebury College, Bates College, University of Havana, Lowell Technological Institute, Notre Dame University, Union College, Bowdoin College, Northeastern University, Duke University, Boston University, Harvard University, Williams College, Lehigh University, University of Pennsylvania, University of Chattanooga, Tufts University, Amherst College, University of California, and Drexel Institute of Technology.

(*Concluded on page 278*)

New York Telephone Co., Jamaica, L. I.
Voorhees, Walker, Smith & Smith, Architects

Good guide in selecting a builder

Most companies we work for carry on building projects continuously. They know what constitutes good service—and where to get it!

W. J. BARNEY CORPORATION
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INDUSTRIAL CONSTRUCTION
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Alfred T. Glassett, '20, President

Radio Telescope at Harvard University's Agassiz Station Observatory.

Banks of Hycon Filters . . . Section of Radio Telescope Receiver designed and built by Ewen Knight Corporation.

Simultaneous detection of 20 signals from neutral hydrogen . . .

another problem solved by HYCON FILTERS

Extending man's view into the depths of the universe is a giant new Radio Telescope at Harvard University's Agassiz Station Observatory. Astronomers are reconstructing the spiral structure of our Milky Way by measuring Doppler Shift of radio signals originating from neutral hydrogen.

ELECTRICAL SPECIFICATIONS - NARROW BAND SERIES

Frequency range: 10 Kc - 30 Mc

Relative Bandwidth: .02% to .5% of center freq.

	Type 11	Type 22	Type 44
Shape Factor:	8	3	1.8

Playing a vital role in the Radio Telescope Receiver which makes these measurements possible are Crystal Filters designed and manufactured by Hycon Eastern. Hycon Filters were selected for their accuracy, stability and selectivity. Spaced at 100 Kc intervals from 5.5 Mc to 9.5 Mc, these Type 11 Filters from Hycon's Narrow Band Series have a 3 db bandwidth of 5 Kc and insertion loss of less than 3 db.

Hycon Eastern is currently producing Crystal Filters in the 10 Kc to 30 Mc range. Because they make possible a reduction in the number of conversions, Hycon Filters are finding wide application in mobile and fixed radio receivers and transmitters.

Write for Crystal Filter Bulletin.

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Affiliated with HYCON MFG. COMPANY, Pasadena, California

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N. B.

Write for the folder describing activities of The Lincoln Laboratory:

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MEMORY DEVICES
TRANSISTORIZED
DIGITAL COMPUTERS
SCATTER COMMUNICATIONS
SOLID STATE
AEW (air-borne early warning)
SAGE (semi-automatic ground environment)

. . . and others which are integral parts of the nation's air defense system.

Our need for qualified PHYSICISTS, ENGINEERS and MATHEMATICIANS is urgent.

RESEARCH AND DEVELOPMENT

MIT LINCOLN LABORATORY

Box 28, Lexington 73, Massachusetts

THE TABULAR VIEW

(*Concluded from page 276*)

Regional Conferences. — The Regional Conferences held in Tulsa and Chicago in February are reported (pages 302 and 303) by VOLTA W. TORREY and JOHN I. MATTILL, both of the Institute's Public Relations Office. As Director of Television, Mr. Torrey is actively engaged in initiating program material for M.I.T. educational programs from WGBH-TV, channel 2. Mr. Mattill is Director of Publications and responsible for producing many publications emanating from M.I.T. each year. He is also assistant to the Director of Public Relations.

Lock, Stock, and Barrel. — A lesson in economics as well as in manufacturing technology is provided in the article (page 304) by FREDERIC W. NORDSIEK, '31, who has been an editorial associate of The Review since 1944. Mr. Nordsiek received the S.B. degree in biology from M.I.T. in 1931 and has since been engaged in research, teaching, and administration in public health and food technology. He is a fellow and life member of the American Public Health Association, and past chairman of its Food and Nutrition Section. As a free-lance writer, Mr. Nordsiek has published 129 articles in the past 15 years (including several for encyclopedias and many for The Review) and also several poems. He is now executive officer of the Research Department of the American Cancer Society in New York.

GEARS

Made to Your Specifications

You and we can form a team—you to draw up the specifications; we to make the gears—that will be profitable to both of us. Gears of all types, all sizes, all materials. Design-engineering service available.

Custom Gears Exclusively

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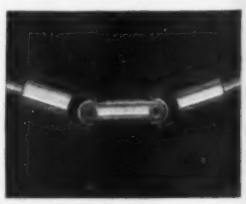
DIEFENDORF GEARS

How Curtis helped a design engineer

"BEAT THE HEAT"

This single universal joint in a ribbon-stripping machine was operated at a 34° angle. The joint heated up, wear was excessive. (Curtis Joints have been tested at angles up to 37°, but we do not recommend angles greater than 30°.)



Curtis engineers recommended a *double* Curtis joint, which reduced the angle to 17° per joint. Result: no overheating, improved efficiency, longer life.

You can depend on Curtis engineering in any problem of angular power transmission. And you can depend on

CURTIS UNIVERSAL JOINTS because our catalog torque and load ratings are substantiated by constant tests under production conditions.

14 SIZES ALWAYS IN STOCK
⅜" to 4" O.D.
(6" joints on special order)

Not sold through distributors. Write direct for free engineering data and price list.

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UNIVERSAL JOINT CO., INC.
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As near to you as your telephone

EXCLUSIVELY A MANUFACTURER OF UNIVERSAL JOINTS SINCE 1919

Keeping water out in the rain

MASONRY WALLS made of brick, stone, or concrete have long stood the test of time. But today, they can be made even better with a coating of silicone water repellents. These amazing materials prevent damaging rainwater from entering the countless tiny pores or openings in masonry structures.

When the water freezes after penetrating, it can cause spalling—cracks off small pieces. And, if it seeps all the way through to the inside of a building, paint peels . . . woodwork warps . . . plaster stains and cracks.

Now, silicone water repellents provide the answer. Brushed or sprayed on the surface, they line—not seal—the pores in masonry. Even heavy rain driven by hurricane winds cannot break through this invisible raincoat . . . yet, because the pores are not sealed, moisture from within can evaporate freely.

The people of Union Carbide produce silicones for other uses, too . . . automobile and furniture polishes, lubricants, electrical insulation, and new rubber-like products . . . all of which help bring more and better things for all of us.

STUDENTS AND STUDENT ADVISERS: *Learn more about career opportunities with Union Carbide in* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Write for "Products and Processes" booklet C-2.*

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MIGHTY CONES FOR LITTLE CHIPS!

These cone bottoms for two 11′ x 43′ pulp digesters typify Graver's skill and craftsmanship in stainless-clad fabrication. Designed for an operating pressure of 126 psi, the digesters are made of Type 316 stainless cladded to firebox quality steel. Digesters are but one of many types of pressure and storage vessels for which Graver's century-long fabricating experience is employed by industry.

ALLOY DIVISION

1857-1957 GRAVER

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GRAVER TANK & MFG. CO., INC.

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HOUSTON • LOS ANGELES • FONTANA, CALIFORNIA • SAN FRANCISCO

All This — AND A HUSBAND WHO'S A WESTINGHOUSE ENGINEER

HAPPY? What wife wouldn't be, knowing her husband will enjoy all the advantages of a creative career in *Atomic Power* with *Westinghouse*, while her family derives all the advantages of living in NEW Pittsburgh. There's good reason why this vast metropolis is called *"The Renaissance City of America."* You need only see the lovely new homes, modern schools, smart shops, and inspiring cultural centers that blanket the city, and you know there is no finer locale for your career as a home-maker, and your husband's career as a *Westinghouse* engineer.

***Do You Know That* PITTSBURGH:**

- Has a population of 2,318,050
- Is the Atomic Center of the free world, thanks to the pioneering efforts of Westinghouse Electric Corp.
- Has more large department stores than any city between New York and San Francisco
- Has 5 colleges and universities
- Has built more than 60,000 dwelling units in its city and suburban area during the past 5 years
- Has 7 leading hotels; 92 newspapers and periodicals; 18 radio and 3 television stations
- Has 100 independent elementary and high school districts, including over 850 public and parochial schools in its city and suburban area
- Has over 1200 houses of worship of all denominations
- Has 22 parks, 9 parkiets, 20 recreation centers, zoos, golf courses, hunting and fishing retreats; and professional baseball, football and hockey teams
- Has countless movies, drive-ins, play houses; art and musical shows, exhibits, and organizations.

NO DELAYS AWAITING SECURITY CLEARANCE.
Responsible positions that offer immediate opportunities.

ELECTRICAL ENGINEERS Degree; design, application, test and analysis of instrumentation and control systems and components.

MECHANICAL ENGINEERS For liaison. Power Plant machinery layout. Some stress, supervise final installation. Degree required.

HEAT EXCHANGER ENGINEERS Mechanical engineers for design and manufacturing follow of heat exchangers and steam generators for high pressure service. Degree required.

MANUFACTURING ENGINEERS Experienced pumps, valves. Work as liaison between engineering department and vendors on centrifugal pumps and other semi-standard centrifugal and positive placement pumps and valves.

METALLURGICAL ENGINEERS Responsible for materials and processes application to marine nuclear power plants.

Send your resume to: Mr. John D. Batey, Dept. #A-5
Westinghouse Electric Corporation,
P. O. Box 1047, Pittsburgh 30, Penna.

Westinghouse
ELECTRIC CORP.
First in Atomic Power

. . . pioneers in nuclear energy since 1936

At the University of California Radiation Laboratory, Berkeley and Livermore, there is an unusual spirit among scientists and engineers — a spirit stimulated by association with pioneers in nuclear research who encourage development of new ideas, techniques, and individual initiative.

Since its founding in 1936, UCRL has contributed an impressive list of achievements to the world's knowledge of the atomic nucleus — from development of the cyclotron and Bevatron, to electromagnetic separation of uranium-235, to the discovery of the antiproton and antineutron.

These accomplishments have, of course, stemmed from an outstanding group of men working with unmatched laboratory facilities. But just as important—and the key, perhaps, to UCRL's successes—has been the spirit with which these men work.

For UCRL is managed and directed by scientists and engineers—men who are liberal with their own knowledge and enthusiastic in the encouragement of their teammates' new ideas and new techniques.

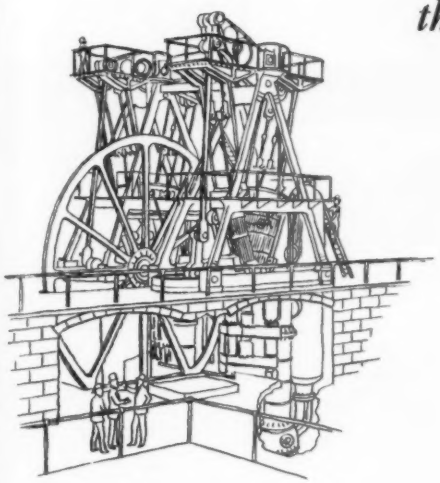
This is the constant and continuing spirit of UCRL. It is to be found in each new and expanded project—whether it involves pure or applied science. It keynotes work on nuclear weapon design, nuclear propulsion, controlled thermonuclear energy (Project Sherwood), and high current accelerators, as well as such problems as the application of radioactive substances to biology and medicine.

The UCRL "spirit" appeals to a particular kind of scientist and engineer—to men of ability and imagination, to men who wish to move forward and challenge the unknown. If you wish additional information, write to the Director of Professional Personnel, University of California Radiation Laboratory, Livermore, California.

UNIVERSITY OF CALIFORNIA RADIATION LABORATORY · BERKELEY · LIVERMORE

During the late **19th CENTURY**

this cumbersome machine
set the pace in large pumping units



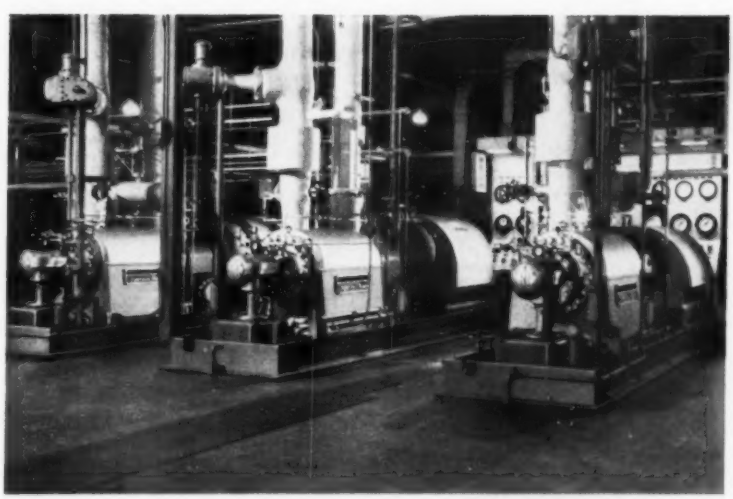
TYPICAL of the massive pumping units that prevailed during the late years of the nineteenth century, this machine supplied water to a New England municipality. Of formidable appearance, it was considered the sensation of its day.

TODAY *it's the modern* **BOILER FEED PUMP**

. . . marking another milestone
in pump development by Ingersoll-Rand

IN power plants throughout the country, modern Ingersoll-Rand boiler feed pumps are being specified again and again to meet the increasing demand for heavy-duty high-pressure service. These trim, compact multi-stage pumps, of the solid forged-steel barrel-casing design, are delivering trouble-free performance with sustained efficiency for pressures from 1000 to 6500 psi and capacities up to 2800 gpm.

If you'd rather help *make* industrial history than read about it, why not look into the fine job opportunities available with Ingersoll-Rand. For further information, contact your Placement Office or write Ingersoll-Rand.



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COMPRESSORS • BLOWERS • GAS & DIESEL ENGINES • PUMPS • VACUUM EQUIPMENT • AIR & ELECTRIC TOOLS • MINING & CONSTRUCTION EQUIPMENT

BOSTON TO NEW YORK

231 miles...on four blown-out tires!

HERE WE GO! We blew out all four tires with a knife. Now we're moving through Boston's Copley Square. This stop-and-start city driving is no tea party for 4 blown-out tires. But the tough nylon "inner tires" take the punishment in stride . . . make us feel certain we'll reach New York safely.

175 MILES OUT! We're near the posted speed limit of 55. Are we worried? Not a bit! This double air chamber principle is backed by millions of miles of LifeGuard experience.

231 MILES LATER! We arrive in Times Square on those four blown-out Captive-Air Safety tires! No damage to the "inner tires"—no damage to the outer tires other than the knife cuts.

Goodyear's new nylon Captive-Air Safety tires made tire changes unnecessary. You, your wife and children can be virtually free from the danger of blowouts and punctures . . . the inconvenience of roadside tire changing.

The Captive-Air Safety tire, tested and proved in Detroit, is now standard and optional equipment on some of America's finest cars. See it this week. Goodyear, Akron 16, Ohio.

Here's how Captive-Air works:

Left: Only the air in the outer chamber escapes when the Captive-Air tire is cut, torn or blown out.

Right: Reserve air in the built-in spare supports the car—lets it drive on for 100 miles or more.

MORE PEOPLE RIDE ON GOODYEAR TIRES THAN ON ANY OTHER KIND!

Only Goodyear has CAPTIVE-AIR . . . the safety tire with the built-in spare!

GOODYEAR TIRES

GOODYEAR

Ask about our Lifetime Guarantee. No time limit! No mileage limit! No expiration date!

LifeGuard, Captive-Air, T.M.'s, The Goodyear Tire & Rubber Company, Akron, Ohio

Photo by Three Lions

Old storehouses along the river's shore at Trondheim, Norway

Technology Review

TITLE REGISTERED, U. S. PATENT OFFICE

Edited at the Massachusetts Institute of Technology

VOL. 59, NO. 6

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A critical appraisal of the Soviet brand of communism — which has dominated Russian people for nearly 40 years and satellite countries for more than a decade — is given by the Director of the Central Intelligence Agency

TECHNOLOGY SHAPES OUR FUTURE ..... By James R. Killian, Jr. 299
The doctrine that our industrial technology leads only to mediocrity of the mass and stultifying standardization is challenged. Rather technology is seen as augmenting the quality of life, encouraging individuality, and enhancing man's excellence, dignity, and productivity

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EDITOR:
B. Dudley

BUSINESS MANAGER:
R. T. Jope

CIRCULATION MANAGER:
D. P. Severance

EDITORIAL ASSOCIATES:
Paul Cohen
J. R. Killian, Jr.
F. W. Nordsiek
J. J. Rowlands

EDITORIAL STAFF:
Ruth King

BUSINESS STAFF:
Eileen E. Klimowicz
Madeline R. McCormick

PUBLISHER:
H. E. Lobdell

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R. Eugene Gustafson

Receptive Attitude

The Technology Review

VOL. 59, No. 6 APRIL, 1957

The Trend of Affairs

Bohr Receives Atoms for Peace Award

■ Niels Bohr, Director of the Institute for Theoretical Physics at Copenhagen, was named the first recipient of the Atoms for Peace Award, according to an announcement by President James R. Killian, Jr., '26, made in New York on March 13, just as The Review goes to press. The award was established by a Ford Motor Company appropriation of $1,000,000 as a memorial to Henry Ford and Edsel B. Ford, and will be used at the rate of $100,000 annually for 10 years. The award is made to advance the use of atomic energy for peaceful purposes by granting awards for outstanding contributions in this field.

In making his announcement, President Killian disclosed that a distinguished company of scholars had unanimously selected Professor Bohr to be the first recipient of the Atoms for Peace Award in recognition of his basic theoretical work on the structure of the atom and his clarification of basic concepts of quantum mechanics. Professor Bohr was awarded the Nobel Prize in Physics in 1922.

Synthesis of Penicillin

■ Chemical synthesis of penicillin, which for years has been one of the most baffling problems in chemistry, has been accomplished at M.I.T. by John C. Sheehan, Professor of Organic Chemistry, and Kenneth R. Henery-Logan, research associate in the Department of Chemistry.

Ten new kinds of the synthetic penicillin are now being tested for possible medical use, Dr. Sheehan said. While the new chemical method probably will not be cheap enough to compete with the established fermentation process by which penicillin is derived from molds, it is hoped that new forms will prove effective against disease organisms now resistant to natural penicillin and against a wider variety of infections. New penicillins might also have less tendency to produce allergic reactions.

The penicillin molecule is not an unusually complex one. Similar molecules, such as those of quinine, morphine, cortisone, and sucrose, had yielded to synthesis. But the penicillin molecule is unstable and disintegrates easily—especially at one point in the process. Constructing it in the laboratory has been compared to placing an anvil on top of a house of cards. The final step is exceedingly delicate.

During World War II, it is estimated that 1,000 chemists worked in 39 laboratories in the United States and Great Britain in the attempt to synthesize penicillin. One group did succeed in producing a microscopic quantity but the process was not a methodical one and practical production was out of the question. At that time, the structure of the molecule was not even understood.

By 1948, when Dr. Sheehan undertook the task, other chemists had given up and many were skeptical as to whether penicillin could ever be synthesized. He persevered and with the help of graduate and post-doctoral students continued the laboratory work for nearly nine years. Final results were announced in the *Journal of the American Chemical Society* which appeared in March.

The Sheehan process employs novel reactions and technology which are expected to be useful in solving other chemical problems. It consists chiefly of a series of reactions at room temperature or below. The crucial step occurs when a carbon atom is bonded to a nitrogen atom, completing the structure of the final product, phenoxymethylpencillin, which is known as penicillin V, the antibiotic which is commonly administered by mouth.

The research has been aided financially by Bristol Laboratories of Syracuse, N.Y. Medical research is being conducted by Merck, Sharp and Dohme Research Laboratories at Rahway, N.J., where the 10 new types of the synthetic penicillin were prepared. These types are all antibiologically active and could not have been obtained through the fermentation process. They are being tested on animals.

Dr. Sheehan participated in penicillin research during World War II at the Merck laboratories and was instrumental in devising a practical synthesis of penicillamine, which is a key compound in the synthesis of penicillin. He also has synthesized other compounds which play a part in the final process.

In 1946 Dr. Sheehan joined the M.I.T. Faculty. In 1951, when he was 36 years old, he received the

American Chemical Society Award in Pure Chemistry for his work on penicillin and for his contributions during the war to the development of the Bachmann process for preparing RDX, which is a high explosive.

Visiting Committee Report on Economics and Social Science

■ The Visiting Committee on the Department of Economics and Social Science* met at Cambridge and Boston for an all-day meeting on Sunday, March 4, 1956. There were present, for the Committee, Messrs. William A. Coolidge, Clarence D. Howe, '07, Robert D. Patterson, '20, Lloyd G. Reynolds, and James M. Barker, '07, chairman. President James R. Killian, Jr., '26, Vice-president Julius A. Stratton, '23, and Institute Secretary Robert M. Kimball, '33, represented the M.I.T. Administration for all or part of the sessions. John E. Burchard, '23, Dean of the School of Humanities and Social Studies, and Professor Ralph E. Freeman, Head of the Department, represented the Faculty throughout.

The morning session was devoted to presentations by seven senior members of the Department's Faculty who spoke on their individual curriculum responsibilities. Professor Max F. Millikan outlined the activities of the Center for International Studies. The Department's entire Faculty met with the Committee for luncheon at the Faculty Club. The afternoon session included one Faculty member presentation, followed by an executive session of the Committee with the officers of administration and Dr. Freeman. Senior Faculty members and some of the Administration officers joined the Committee at the Algonquin Club for dinner and general discussion in the evening.

The Committee believes that the meeting was productive in that major aspects of the Department's curriculum were discussed by, and with, the Faculty members responsible. This Department is one of the most important at the Institute, and covers a very wide range of economic and related subjects. It is the opinion of the Committee that progress is generally satisfactory.

The Committee listened with especial interest to Dr. Millikan's presentation of the work of the Center for International Studies. This very large operation is not integrated with the Department of Economics, although several members of its staff are also members of the Department of Economics Faculty. Dr. Millikan reports directly to the Dean of Humanities and Social Studies and not to the Head of the Economics Department. In view of the size, importance, and special nature of the Center's activities, the Visiting Committee was unanimously of the opinion that a Visiting Committee for the Center should be promptly designated by the Corporation. Such committee would have as its function a careful review of the Center's work, its accomplishment to date, and its potential usefulness both to M.I.T. and to the entities which make or might make use of its product. The magnitude and importance of the Center's operations are such that it should no longer be included in the responsibilities of the Visiting Committee on the Department of Economics.

The Committee expresses its appreciation of the help given it by the administrative officers of the Institute, and by Dean Burchard and Professor Freeman and his associates on the Department's Faculty.

The report of the Visiting Committee was reviewed by the Executive Committee on August 30, and by the M.I.T. Corporation on October 1. It was submitted to The Review for publication on October 25, 1956.

* Members of this Committee for 1955–1956 were: James M. Barker, '07, chairman, Clarence D. Howe, '07, Robert D. Patterson, '20, Harold R. Boyer, '22, William E. Huger, '22, William A. Coolidge, Harry D. Gideonse, Alfred C. Neal, and Lloyd G. Reynolds.

Individuals Noteworthy

■ The first few months of the year brought forth the following promotions, elections, and appointments:

Raymond H. Blanchard, '17, as a member of the Corporation of Northeastern University, Boston . . .

Winfield I. McNeill, '17, as Vice-president of the newly organized firm of Calkin and Bayley, Inc., New York, industrial consultants . . .

John M. Campbell, '25, and *Arthur F. Underwood, '26,* respectively, as Scientific Director, and Manager of Research Staff Activities of General Motors Corporation . . . *Lester C. Smith, '25,* as President of Spencer Turbine Company, Hartford . . .

James W. Dunham, '26, as President of Compressed Gas Association, Inc., New York . . . *James A. Merrill, '30,* as Associate Director of Research and Development of the Goodyear Tire and Rubber Company, Akron . . .

John D. Northup, '32, as Vice-president of the Mill Division, Owens-Illinois Glass Company, Toledo . . . *Wayne M. Pierce, Jr., '37,* as Vice-president for Engineering and Manufacturing of Norden-Ketay Corporation, Stamford . . .

John R. Brown, Jr., '39, as Vice-president of Research and Development for Spencer Chemical Company, Kansas City, Mo. . . .

John G. Truxal, '47, as Head of the Electrical Engineering Department at the Polytechnic Institute of Brooklyn.

■ Recent honors have been presented to Alumni and members of the Institute's Faculty as listed:

To *Anatole R. Gruehr, '24,* a fellow of the American Institute of Electrical Engineers in recognition of his "application of economic theory to engineering design" . . . to *Ralph H. Swingle, '30,* the Order of Merit for Distinguished Service, from Westinghouse Electric and Manufacturing Company – the company's highest award . . .

To *George E. Valley, Jr., '35,* the Air Force's Civilian Exceptional Service Award, presented by Donald A. Quarles, Secretary of the Air Force . . .

To *Elias Burstein, '43,* the Annual Award of the Washington Academy of Sciences, for Scientific Achievement in the Physical Sciences for 1956, "in recognition of his distinguished study of impurity levels and effective electron masses in semi-conductors."

100 Per Cent Participation

■ The 321st meeting of the Alumni Council, held on the evening of January 21 at the M.I.T. Faculty Club, marks the beginning of a new era in Council support of Alumni activities. It was at this meeting, over which Theodore T. Miller, '22, presided as President of the Alumni Association, that John W. Kilduff, '18, was able to report that each and every member of the Council had contributed to the Alumni Fund for 1957.

But this news was held for a relatively late portion of the business session of the meeting. First item on the agenda was a report presented by President Killian on a recent study of the Struik case by a committee of the Massachusetts State Legislature. A resolution on the late William A. Ready, '13, for many years a member of the Council, was read by Edward H. Cameron, '13 (chairman of the committee which prepared the resolution), and adopted by silent rising vote of the Council members.

As Secretary, Donald P. Severance, '38, reported: (1) changes in class affiliation for three Alumni; (2) that eight members of the M.I.T. staff and officers of the Association had visited 11 M.I.T. clubs between November 29 and January 17; (3) that the new M.I.T. Club of Peru at Lima had been recognized by the Executive Committee as the 93d M.I.T. Club and the 25th outside the limits of continental United States; (4) changes in new representatives on the Council. As Treasurer for the Association, Mr. Severance reported that the Executive Committee had approved a supplementary budget of $3,885 to cover equipment required as a result of moving of the Alumni Records Office last summer, contributions to a revised M.I.T. Pension Plan, and printing of Newsletters and folders for Alumni work.

Members of various subcommittees for the 1957 Alumni Day were announced; the total committee personnel is: D. Reid Weedon, Jr., '41, general chairman; David W. Skinner, '23, deputy chairman; *Conference* – Henry B. Backenstoss, '34, chairman, Arthur A. Nichols, '28, Manson Benedict, '32, Edward G. Sherburne, Jr., '41, William R. Jones, '49, J. Peter Anderson, staff; *Banquet* – Dr. Egon E. Kattwinkel, '23, chairman, Percy R. Ziegler, '00, Henry B. Kane, '24, Helge Holst, '31, Claude F. Machen, '31, Mrs. Julius A. Stratton, Miles P. Cowen, staff; *Luncheon* – William L. Taggart, Jr., '27, chairman, Francis B. Kittredge, '21, Glenn D. Jackson, Jr., '27, William H. Carlise, Jr., '28, Fisher Hills, '29, Frederick B. Grant, '39, Raymond R. Richards, '43; *Publicity* – John T. Fitch, '52, chairman; *Reception* – William Morrison (Faculty Club), chairman; *Registration* – Wolcott A. Hokanson, staff, chairman, G. Edward Nealand, '32, Robert E. Hewes, '43.

Chenery Salmon, '26, chairman of the 1957 Midwinter Meeting Committee, spoke briefly on the program for this meeting and urged Council members to make early reservations.

Mr. Miller next called on Mr. Kilduff who had been appointed in October as chairman of a special committee to be responsible for obtaining an early 100 per cent participation in the 1957 Alumni Fund by members of the Council. Mr. Kilduff reported that his committee had been working toward a January 21st deadline. The goal of 100 per cent participation by the Council was met that very day.

Avery H. Stanton, '25, chairman of the Alumni Fund Board, reported on the response to the 1957 Alumni Fund. On January 21, a year ago, 6,500 Alumni had given $234,568. On the same date this year 7,550 Alumni had contributed $280,000. Of the total, about $50,000 has been designated for the use of scholarships.

The rest of the evening was devoted to the first public showing of a new film, "The Social Beaver," which, as the name implies, depicts the nonacademic aspects of M.I.T. undergraduate life. This film was designed at the request of the Admissions Office for groups of Alumni and prospective students. It was filmed and produced by Oscar H. Horovitz, '22, who has held numerous offices in amateur cinema organizations here and abroad and whose films have won 22 national and international awards. Since the film shows many social and athletic activities new to Alumni, the head table included a panel of experts to give further details and to answer questions. They were: Paul M. Chalmers, Associate Director of Admissions, moderator; John T. Rule, '21, Dean of Students; Frederick G. Fassett, Jr., Dean of Residence; Klaus Liepmann, Professor of Music; and Richard L. Balch, Director of Athletics.

On the Horizon

June 10, 1957 – 23d Alumni Day, 1957, M.I.T. Campus in Cambridge.

September 6–7, 1957 – 2d Alumni Officers' Conference, M.I.T. Campus in Cambridge.

December 7, 1957 – 11th M.I.T. Alumni Regional Conference, Pittsburgh, Pa.

Appointment in Philosophy

■ Appointment of Hans Meyerhoff as visiting associate professor of philosophy at the Institute for the 1957 spring term was announced late in January. Dr. Meyerhoff will come to M.I.T. from the University of California at Los Angeles, where he has been associate professor of philosophy since 1948.

A naturalized United States citizen, Dr. Meyerhoff was born in Braunschweig, Germany, on December 1, 1914. He received his bachelor's degree from the University of California at Berkeley, and the Ph.D. in 1942 from the University of California at Los Angeles. During World War II he served overseas with the U.S. Army's Office of Strategic Services, and from 1945 to 1948 he was a political analyst for the State Department in Washington, D.C. He has been associate professor in the Department of Philosophy at U.C.L.A. since 1948, except for the fall term of 1955 when he was visiting associate professor in the Department of Philosophy at the University of Michigan.

Dr. Meyerhoff is widely known for his many articles and reviews on philosophy. He is author of *Time in Literature*, published by the University of California Press in 1955, and the *English Version of Plato*.

Class Reunions in 1957

Class	*Date*	*Place*	*Reunion Chairman or Class Secretary*
1897	June	Boston – Tentative luncheon plans	John P. Ilsley, 26 Columbine Road, Milton 87
1902	June 7-9	Wentworth-by-the-Sea, Portsmouth, N. H.	Burton G. Philbrick, 18 Ocean Avenue, Salem
1907	June 7-9	*50th Reunion* Oyster Harbors Club, Osterville	Bryant Nichols, 23 Leland Road, Whitinsville
1908	June 7-9	Melrose Inn, Harwich Port	H. Leston Carter, 14 Roslyn Road, Waban 68
1912	June 7-9	Snow Inn, Harwich Port	Albion R. Davis, 11 Vane Street, Wellesley
1916	June 11-12	Chatham Bars Inn, Chatham	Harold F. Dodge, Bell Telephone Laboratories, 463 West Street, New York 14, N. Y.
1917	June 7-9	Wentworth-by-the-Sea, Portsmouth, N. H.	Stanley C. Dunning, 21 Washington Avenue, Cambridge
1922	June 7-9	Sheldon House, Pine Orchard, Conn.	Dale D. Spoor, Apt. 12D, 2440 N. Lakeview Avenue, Chicago, Ill.
			Parke D. Appel, 28 Winthrop Road, Belmont 78
1927	June 7-9	Oyster Harbors Club, Osterville	J. Robert Bonnar, 26 Macy Avenue, White Plains, N. Y.
1932	June 7-9	*25th Reunion* Baker House, M.I.T., Cambridge	Rolf Eliassen, Room 1-138, M.I.T., Cambridge
1937	June 7-9	The Belmont, West Harwich	Philip H. Peters, 14 Cushing Road, Wellesley Hills
1942	June 7-9	Chatham Bars Inn, Chatham	George J. Schwartz, Doelcam Corporation, 1400 Soldiers Field Road, Boston
1947	June 8-9	Hotel Curtis, Lenox	Martin M. Phillips, 41 Avalon Road, Waban 68
1952	June 8-9	Mayflower Hotel, Plymouth	Nicholas Melissas, Building 32, M.I.T., Cambridge

Visiting Professors in Civil Engineering

■ Appointment of Laurits Bjerrum and Giulio Pizzetti as visiting professors in the Department of Civil and Sanitary Engineering at the Institute was announced in January.

Dr. Bjerrum, named visiting professor of soil mechanics, has been director of the Norwegian Geotechnical Institute in Oslo since 1951. Born in Farsø, Denmark, in 1918, he was graduated from the Technical University of Copenhagen and received his doctorate at the Federal University of Switzerland. He began his career as research assistant at the Technical University of Copenhagen and then served as foundation engineer with Ostenfeld and Jønson, consulting engineers. From 1947 to 1951, Dr. Bjerrum was on the staff of the Institute of Soil Mechanics and Foundation Engineering at the Federal University of Switzerland.

Dr. Pizzetti, an engineer specializing in concrete structures, will work with the Departments of Architecture and of Civil Engineering as visiting professor of structural engineering. He was born in Parma, Italy, and received the degree of doctor in civil engineering at the Polytechnic Institute of Turin, Italy. His teaching career there included posts as instructor in science of constructions, assistant professor, and professor of reinforced concrete. The former director of a firm of building contractors in Buenos Aires, Dr. Pizzetti has also served as professor at the School of Architecture, University of Buenos Aires. He is a member of the Italian National Council of Research and has published many papers on the subject of structures, thin shells, and prestressed concrete.

Economist Appointed

■ The appointment of economist Evsey D. Domar as visiting professor in the Department of Economics and Social Science at M.I.T. was announced recently. A professor of political economy at the Johns Hopkins University, he will teach at M.I.T. during the 1957 spring term.

Dr. Domar was born in Lodz, Poland, on April 16, 1914. He holds degrees from the University of California at Los Angeles (B.A. 1939), the University of Michigan (M.A. 1941), and Harvard University (M.A. 1943, Ph.D. 1947). He served as economist for the Board of Governors of the Federal Reserve System in 1943–1946 during World War II, and was assistant professor at Carnegie Institute of Technology in 1946–1947. Dr. Domar was assistant professor in the Department of Economics at the University of Chicago during 1947–1948 before joining the faculty at Johns Hopkins, where he was associate professor in 1948–1955, and became professor of political economy in 1955.

In recent years Professor Domar has also been visiting lecturer at the University of Buffalo, for the February, 1949, term; visiting associate professor at Columbia University's Russian Institute in 1951–1953 and 1954–1955; and lecturer under a Fulbright award at Oxford University in 1952–1953. Since 1954, Dr. Domar has been consultant to the Foreign Study and Research Fellowship Program of the Ford Foundation.

He is author of more than a dozen papers on economic theory and practice. His book, *Essays in Economic Growth*, will be published by the Oxford Press in the near future.

M.I.T. Photos

For the first time the Fund Board of the Alumni Association was host to 50 members of the Class of 1960 to whom Alumni Fund scholarships were awarded for their freshman year. The dinner meeting in the Campus Room of the Graduate House was attended by about 30 Technology Alumni interested in student affairs. Among those present at this dinner were (standing, above, left to right in column two): Avery H. Stanton, '25, chairman of the Alumni Fund Board; Henry T. Perkins, '60, Penobscot, Maine; George D. Giffin, '60, La Canada, Calif.; Lawrence G. Rose, '60, Hialeah, Fla.; Charles W. Bolz, Jr., '60, Everett, Wash.; and Theodore T. Miller, '22, President of the Alumni Association.

Also present at the Alumni Fund scholarship dinner (above, at left, in clockwise order from center opening) were: Norman B. Thayer, '60, Manchester, N.H.; Richard J. Northrup, '60, Mt. Morris, N.Y.; David A. Aaker, '60, Fargo, N.D.; Thomas P. Pitré, Associate Dean and Director of Student Aid; J. Samuel Jones, Assistant to Director, Student Aid; and Gerald M. Litton, '60, Phoenix, Ariz.

Alumni Fund Scholars Dine

■ The Alumni Fund was host to 50 members of the Class of 1960 at a dinner meeting held at the Graduate House on March 4. The freshmen were those awarded Alumni Fund scholarships for their first year of study at M.I.T. as the result of action taken last year to set aside a portion of the Alumni Fund for freshman scholarships. Good fellowship was the order of the evening.

About 30 Technology Alumni or staff members mingled with the 50 students. Theodore T. Miller, '22, President of the Alumni Association, made brief remarks regarding the Alumni organization and its freshman scholarships. Others who spoke at the dinner included Avery H. Stanton, '25, chairman of the Alumni Fund Board, and Thomas P. Pitré, Director of Student Aid. Eugene W. Boehne, '28, Professor of Electrical Engineering, entertained the group with puzzles in mathematics and logic.

Visiting Committee Report on Chemistry

■ It has become apparent that, as a profession, chemistry is attracting fewer undergraduate students at colleges and universities. In 1950, for example, about 3,300 students were awarded the bachelor of science degree in chemistry in the United States. By 1954, this figure had dropped to about 1,800. For M.I.T. the falling off since 1950 corresponds roughly to the national average. It seemed to the Visiting Committee on the Department of Chemistry,* meeting at M.I.T. that it would be appropriate to devote their meeting on March 2, 1956, to a consideration of ways and means of increasing the attractiveness of chemistry as an undergraduate discipline. It was concluded that major attention might well be directed to the content of the course in freshman chemistry since it is presumably during this first year of study at the Institute that chemistry majors are either created or discouraged.

During the morning session, Professor Arthur C. Cope, Head of the Department of Chemistry, arranged for presentation by a number of young members of the Department staff, all of whom had come to M.I.T. from other institutions within the past few years, and all of whom were engaged in teaching freshman chemistry. Their discussions were most stimulating, and gave every indication of thoughtful analysis of ways and means of improving the first year curriculum.

The point was made that the thoroughness and excellence of the chemistry course received by freshmen at their high schools had little to do with their performance at M.I.T. On the average, even those students who had had no previous instruction in chemistry "caught up" with their better-trained associates by the end of the first semester. This would appear to indicate that the caliber of high school chemistry instruction may be important in encouraging young men to consider chemistry as a vocation, but is not a significant influence on their performance at M.I.T.

A system has also been successfully introduced which involves setting up special sections in which instruction is at a somewhat higher level. Enrollment is voluntary, and selection of candidates is made on the basis of high scholastic performance. This system appears to give a needed outlet for brilliant students who can, by joining the special sections, receive instruction which is a greater challenge to them and which could certainly be expected to increase their interest in chemistry as a vocation.

(*Concluded on page 312*)

* Members of this Committee for 1955–1956 were: Crawford H. Greenewalt, '22, chairman, Godfrey L. Cabot, '81, Robert L. Hershey, '23, Eger V. Murphree, '23, Charles A. Thomas, '24, Joseph R. Stevens, '30, M. Gilbert Burford, William M. Holaday, and Harold A. Iddles.

Twenty-five Years Ago This Month . . .

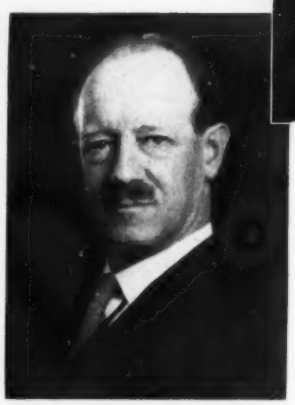
■ The Institute adopted a new plan of administrative organization whereby Vannevar Bush, '16, Professor of Electric Power Transmission, was elected vice-president and dean of engineering; and Professors Samuel C. Prescott, '94, Head of the Department of Biology and Public Health, and William Emerson, Head of the Department of Architecture, became, respectively, dean of science and dean of architecture.

In announcing these appointments, Dr. Compton described the new plan as follows:

"The subdivision of the Institute, for administrative purposes, into the School of Engineering, the School of Science, the School of Architecture, the Division of Humanities, and the Division of Industrial Coöperation, recognizes the five major aspects of its work. The three schools comprise those departments of study in which degrees are given, whereas the two divisions are essentially 'service' divisions. That of the Humanities is designed to give our students that further cultural training and background which we deem an essential part of a well-balanced training. The Division of Industrial Coöperation is designed to make as effective as possible the assistance which the Institute renders to business and industry in solving their technical problems. While the outstanding position of M.I.T. in the field of engineering education is generally recognized, its equally strong position in science and architecture is probably not so widely known, since these activities are not explicitly indicated in the name of the Institute.

Conferring under the portrait of George Eastman, Technology's benefactor, are Vannevar Bush, '16, and the late President of the Institute, Karl T. Compton.

► S. C. Prescott, '94



◄ William Emerson

"An important feature of this new organization is the explicit recognition of the Graduate School. The Institute has awarded approximately one-third of all the advanced degrees in engineering given in this country, and in certain departments, notably in chemical engineering, electrical engineering, and aeronautical engineering, approximately one-half of all the advanced degrees. With every indication that this feature of our work is becoming relatively more important, it has seemed advisable to provide adequately for its recognition and constructive administration.

"Although thus divided into these schools for the purpose of administrative responsibility, the Faculty as a whole will continue to be the final authority."

. . . It was announced in The Review that "the individual minute droplets of which fog is composed have been measured and photographed for what is believed to be the first time in the Institute's research station on the estate of Colonel E. H. R. Green at Round Hill, Mass., according to Professor Edward L. Bowles, '22, Director of the Station. . . . The measurements and photographs were made by Henry G. Houghton, Jr., '27, a research assistant, who with Dr. Julius A. Stratton, '23, has made a comprehensive study of various kinds of fog."

. . . Congratulations were being extended to Frederick W. Barker, '12, upon becoming Vice-president of the First Trust and Deposit Company of Syracuse, N.Y.; and to Albert F. Hegenberger, '17, upon his promotion to Captain, Air Corps, U.S. Army. As a first lieutenant on June 28–29, 1927, with Lieutenant Lester J. Maitland, he had made the first non-stop 2,400-mile flight from San Francisco to Honolulu; in World War II he became a Major-General.

From High School to Executive Development

■ As has been customary for a number of years, two addresses were given at the conclusion of the business portion of the 322d meeting of the M.I.T. Alumni Council, held at the Faculty Club on February 25. First of the two speakers at this meeting was Bruce F. Kingsbury, 2-44, Executive Secretary of the M.I.T. Educational Council, whose topic "Long-Range, Grass Roots Promotion" dealt with the aid which selected Alumni are giving, in the field, to high school students desiring to study at the Institute. The second speaker was Howard W. Johnson, Associate Professor of Industrial Management and Director of the Executive Development Programs, whose topic was "An Evaluation of Executive Development Programs." In a sense, therefore, this Council meeting dealt with a range of topics from the high school student to the business executive.

Mr. Kingsbury described the purposes of the Educational Council and some of the ways it serves the Institute. Basically, the object of the Council is to provide M.I.T. with more well-qualified students. To achieve this goal most of the efforts of the Council are directed at the high school teachers and, in particular, the persons in the high schools designated as guidance counselors or college advisers.

Since 1931 "Ambassadors of M.I.T.," called Honorary Secretaries, have been appointed for the purpose of representing M.I.T. in their communities. For years this took the form of interviewing prospective freshmen, representing the President of M.I.T. at local college events, and occasionally seeking contact with secondary schools.

In 1951 this group was expanded into the Educational Council, a more formal organization to carry out active, yet moderate, public relations with secondary schools, students and parents, teachers, and others concerned with guiding future collegians.

The Educational Council is organized on a geographical basis. Usually an alumnus is assigned to one or two high schools in his area. He is expected to visit these schools occasionally, which know of his selection from a letter from M.I.T.'s president.

Each Council member seeks to develop a friendship with the principal in small schools or with the director of guidance or a teacher in the larger schools. He makes himself available to answer questions about M.I.T., offers to talk with groups of students about the Institute or about science and engineering education in general, arranges plant visits, offers to talk about his profession or gets specialists to cover a certain field, represents M.I.T. at the school's annual career day, and assists our Admissions Office school visitors on their annual circuits. Otherwise, many students are dissuaded from making application to the Institute by persons who are largely ignorant of schools like M.I.T. There are currently 700 members of the Educational Council. Thirteen hundred high schools are now represented. Last year the Admissions Office referred over 5,000 potential applicants to members of the Educational Council — over 3,000 of these were actually interviewed by the Educational Counselors.

Professor Johnson pointed out that most of the training and development of an executive takes place within the company itself, but a portion of the job can properly be assigned to the universities. He referred to three areas of growth for the executive. Development of "know-how"; the ability and incentive to run business, and to make money doing it, can be developed within the company and by the man himself. The area of leadership, or the ability to motivate others to take action to reach a particular goal, is an area in which the university can make significant contributions. The third area, a development of a knowledge and understanding of the business environment, the industry as a whole, its history, and the labor and national and international ranges of effects on the business is very difficult to achieve within any company. Here the university can make the greatest contribution and here is where the company programs do their poorest job. Professor Johnson discussed in detail what M.I.T. is doing in executive development programs: the Sloan Fellowship Program which is the oldest E.D.P. in the country. The second program he described is one which began just last year, a 10-week program for senior executives on a vice-presidential level.

Prior to these two addresses, the business portion of the meeting (at which Past President Dwight C. Arnold, '27, presided in the absence of President Theodore T. Miller, '22) was opened at 7:40 P.M. with approval of the minutes of the January meeting.

As Secretary-Treasurer of the Association, Donald P. Severance, '38, reported that: (1) the Executive Committee had voted approval for change in class affiliation of five Alumni; (2) visits to eight M.I.T. clubs and two Regional Conferences were made by 22 members of the Council or M.I.T. staff since the last Council meeting; and (3) the conferences in Tulsa and Chicago (please see pages 302, 303) had been unusually successful.

The names of candidates from Districts 3, 6, and 7, as nominees to serve on the National Nominating Committee were read by Mr. Severance. Candidates of classes whose numerals end in 3 or 8 to serve on the Alumni Council for a five-year term were also announced.

As chairman of the National Nominating Committee, Horatio L. Bond, '23, reported nominations of officers for the Alumni Association as recorded on page 237 of the March issue of The Review.

D. Reid Weedon, Jr., '41, chairman of the Alumni Day Committee, announced that all events would be held on the M.I.T. campus on Monday, June 10; that the Karl Taylor Compton Laboratories are to be dedicated on Alumni Day; that guests will be able to visit the nuclear reactor which will then be under construction; that a symposium will be held in the morning; and that the pre-banquet social hour, banquet, and performance of Boston Pops Orchestra (with Arthur Fiedler conducting) will conclude events of Alumni Day.

Henry B. Kane, '24, Director of the Alumni Fund, reported that 8,840 Alumni had contributed $402,555 to the Alumni Fund for the current season. Corresponding figures for the same period, a year ago, were 8,100 Alumni who contributed $345,000.

Professor of Philosophy

■ Appointment of Huston Smith, now on the faculty at Washington University, St. Louis, as Professor of Philosophy at the Institute was recently announced.

Dr. Smith will be the first professor of philosophy at M.I.T. since the early days of the Institute, according to Professor Howard R. Bartlett, Head of the Department of Humanities. His appointment will greatly strengthen the program offered by the new combination majors of Humanities and Science and Humanities and Engineering.

The son of missionaries, Dr. Smith was born in Soochow, China, and he went to high school in Shanghai. He was graduated from Central College in Missouri and received his Ph.D. from the University of Chicago. His special field is philosophy of religion. He was lecturer at the University of Colorado and, in 1946–1947 was director of religious activities at the University of Denver before going to the Washington University faculty in 1947. He also taught at the Iliff School of Theology in Denver.

Dendrochronology

■ By methods established long ago but recently improved, it is now possible to date, exactly, prehistoric remains of human culture extending back into the pre-Christian era, so long as they include some wooden construction. These methods are based on the following facts:

1. In some areas, thickness of annual growth rings of local trees is governed by a single limiting environmental factor. In dry regions this factor is total rainfall; in cold regions it is mean annual temperature.

2. Hence the sequence of thick, thin, and medium-sized rings in the trees of a given locality reflects fluctuations of climate, and forms a recognizable pattern for any particular sequence of years.

3. There are now living trees as old as 700 years, and cross sections of the annual rings of these trees may be taken without harming the trees.

4. Wood has generally been used as a construction material by man, ancient as well as modern.

5. Tree-ring dating may be tied in with the dating of organic materials by measurement of the degree of decay of C^{14}, the radioactive isotope of carbon. This method provides approximate dates from about 300 years to about 300 centuries in the past.

The tree-ring dating methods have led to a spate of polysyllabic coinages based on the root *dendro*, meaning "tree." Thus *dendrochronology*, based on *dendroclimatology*, makes possible *dendroarcheology*.

How dendrochronology works may be demonstrated by a hypothetical example. Let us say that an old living specimen of a tree species having wide annual ring variation is sampled by means of a tool, like a laboratory cork borer, that extracts a long thin rod of wood, crossing all of the annual rings and extending from the bark to the center of the tree. This tree is found to be seven centuries old; hence its rings reflect annual variations in climate from 1957, the year the specimen is taken, back to 1257, when the tree sprouted. Now, a large beam of the same wood is sought in old houses built in early Colonial times. One is found; and let us say that this wood likewise has about 700 annual rings. There is no way of knowing offhand exactly when this tree was cut. But its precise age may be found by matching its rings with those of the living tree, because the outer rings of the house beam span the same years and hence reflect the same annual climatic variations as the rings laid down about halfway through the life of the living tree. Once the old house beam is dated, its rings would then provide a calendar extending back to the Eleventh Century. If now, wood can be found in pre-Columbian Indian remains, with outer rings matching inner rings of the wood from the old house, the precise year the Indians cut this wood may be determined.

If *very* early wooden beams are discovered, predating the time scale worked out by overlapping tree rings coming forward to living trees, it may be possible to establish a new approximate base by means of radioactive carbon dating, and then to work both forward and backward from there.

The American Southwest is a particularly favorable site for application of dendrochronology. It is a relatively dry region with annual fluctuations in rainfall that show plainly in the tree rings. This area is forested with conifers, trees whose annual ring size is strongly influenced by moisture fluctuations, that survive to great ages, and that are not apt to be injured when penetrated by a sample boring tool. Early Indian remains, many including extensive wooden construction, abound in this section.

The precise dating of prehistoric Indian pueblos in the southwestern states, some of them going back to B.C. times, is a fascinating yarn of methodical, patient study. For over a decade, recent time scales were slowly built up, based on living trees and beams from houses constructed since the coming of the white man. Also, disjointed ancient time scales were established with wood from prehistoric Indian dwellings. Gradually the ancient ring patterns were interrelated, but still did not indicate actual dates because they were not tied to the modern calendar. This work, it should be noted, was done in the 1920's, before radioactive carbon dating methods were available.

Then, in 1929, beams were found that bridged the gap, tying the ancient wood into a time scale based on the modern calendar. Thus precise dating of scores of Indian ruins in the Southwest was achieved. For example, construction in Mummy Cave in the Navaho Indian Reservation, Ariz., was dated in the First Century A.D. A Douglas fir beam in this ruin was found to have been made from a then old tree that flourished before the dawn of the Christian era; to be precise, it sprouted in the year 59 B.C. The rings of this wood provide a clear record of annual rainfall variations in this area from 59 B.C. onward. Thus a base is now available for dating of fir wood remains, from the first half century B.C. up until the present day.

Although the American Indian remains just mentioned are by far the oldest precisely dated human construction known anywhere in the world, dendrochronology has been successfully applied to the dating of ancient wooden construction by man in Alaska, Norway, Sweden, and Germany. Clearly, dendrochronology has become a powerful tool of the archeologist.

Evolution in the Communist World

When the day of freedom for Russia and the peoples under Soviet rule may come, no one can prophesy. But when it comes, it will be the proudest day in Russian history

by ALLEN W. DULLES

It is a great pleasure to have this opportunity to meet with the Mid-America Conference. Its sponsor, M.I.T., is playing a central role in the shaping and maintaining of America's scientific genius. Like our country, which it serves so well, M.I.T. has made important and dramatic forward strides in the past half century.

Winston Churchill, at a convocation of this Institute eight years ago, spoke admiringly of M.I.T.'s resolution to maintain a faculty of the humanities. Your fruitful contacts with so many foreign students and scholars and your launching of a Center for International Studies are further examples of a broad and imaginative approach to the place of technology in the modern world.

There have indeed been many changes since those earlier days when M.I.T. was a small institution on Boylston Street, Boston. America then was a young nation relatively free of the troublesome concerns of world politics. But times do change; and we in this country have never shrunk from the challenge of changing conditions.

In fact, having generally accepted the idea that we live in a world of change, it is perhaps rather surprising that we have been somewhat slow to recognize that this principle also applies to political and social life in the Communist world.

We ascribed to Hitlerite Germany a political solidity which it never had though it took a world war to prove this. Today many of the experts on Soviet and satellite problems have been forced to revise their calculations and pay closer attention to new forces within the Communist world which have been dramatically revealed during the year 1956.

When Khrushchev denounced Stalin a year ago, he said those fatal words which destroy faith and which once said can never be explained away. The flood of self-questioning let loose by the Anti-Stalin crusade has plumbed the depths of doubt about the integrity of the Communist political structure. When history is written, the Khrushchev statement of February, 1956, may well be described as the Kremlin's admission of the general crisis of Communism.

Stalin's Legacy

Stalin died in March, 1953, leaving one of the most reactionary, despotic police states the world has ever known. He had given himself a name which meant steel. He expressed his views in a journal named *Truth*. He had concentrated more power in his own hands than had been commanded even by his own great historical idol, Ivan the Terrible. For nearly 30 years he had exercised arbitrary rule over his own and many other peoples. He had killed most of his friends, and transplanted or annihilated innumerable people.

The prospect of ruling this leviathan without Stalin awed his successors. Indeed the official announcement of his death spoke of the need to "prevent any kind of disorder or panic." This defensive note on the

The sturdiness of this old door is indicative of the strength and endurance of the early settlers of our country who coped with the physical hardships of their day – a distinct contrast to the complex sociological and political problems, such as communism, which face their heirs of the Twentieth Century.

Joe Clark from Black Star

part of the heirs to a seemingly all-powerful state may have been the first of the many hints we were to get of the complexity of the problems faced by Russia's new rulers.

The evolution of the U.S.S.R. over the last four years can be explained in terms of the new Soviet leaders' response to three main problems: problems with themselves; problems with their own and subject peoples; and problems with the outside world.

A Problem within the Leadership

The first problem that the new leaders faced was an elementary one: that of clearly re-establishing their ultimate authority. This is no simple problem in a revolutionary regime with no roots in either historical traditions or popular consent. Dictatorships are rarely transferable or inheritable, and Stalin, like most dictators, made no provision for the succession. He had been busy playing his lieutenants off against one another; he appears to have had no real number 2 man – just a group of number 3 men.

This group set up an uneasy oligarchy, the so-called "collective leadership." Shortly they agreed to get rid of Stalin's Police Chief, Beria, and mitigated some of the worst excesses of his secret police system.

But these very changes were only to help bring to the surface internal problems that had been artificially suppressed during the Stalin era.

A Problem with their Peoples

One of these problems was that of restoring initiative and enterprise to a people numbed by long years of discipline and fear. Little Stalins had set themselves up at the local level throughout Russia, and the satellites, and people everywhere in the Soviet sphere had decided to play it safe.

Thus, while the "system" may have been functioning satisfactorily in terms of the relative increase in industrial production, it was slowly running out of steam. Having let up a little on the stick of the secret police, the oligarchy tried to budge the populace with a carrot.

In the economic sphere, this "carrot" took the form of the so-called "new course" announced by Malenkov in the summer of 1953. This policy promised to give greater attention to the manufacture of consumer goods, which had long been subordinated to the basic Soviet emphasis on heavy industry.

In the intellectual sphere, a prominent Soviet writer called for a new turn to "sincerity" in literature. Writers and artists began to speak of a "thaw" as arrests ceased within their ranks and long-imprisoned artistic and literary figures trickled back from Siberia. The leaven of mass education was beginning to work; and while this paid off handsomely in the field of technology, it had other consequences which proved most unwelcome to the worried men in the Kremlin.

The regime soon found that use of the carrot had to be checked. In the months leading up to the Writers' Congress of December, 1954, attempts were made to reassert the Communist Party's right to regulate art and literature; and Khrushchev reasserted the primacy of heavy industry at the time of Malenkov's demotion early in 1955.

However, the Soviet leaders discovered that they could not go back all the way to conditions as they had prevailed under Stalin; for they found themselves faced with the most serious of all challenges to a totalitarian regime, the revolution of rising hope and expectations. When a tyrant gives real hope to the oppressed, then, in the long run, the position of tyranny as a system tends to become hopeless.

Rising expectations were most serious and hardest for the U.S.S.R. to control on the periphery of Stalin's empire in the East European satellites. The new economic course was taken farthest in Hungary under Imre Nagy in 1953-1955; Hungary went considerably beyond the Soviet Union in playing down heavy industry in favor of consumer goods, and even de-emphasized one of the most hated of all Stalinist exports, the forced collective farm.

Meanwhile, writers in Poland as well as Hungary were going farther than their Soviet counterparts in voicing the pent-up feelings of their countrymen.

Of special importance was a poem which became a *cause célèbre* behind the iron curtain, "A Poem for Adults," by the Polish poet, Adam Wazyk, which was published in Poland in August, 1955. Wazyk spoke with the scourging hate that both writers and ordinary people were coming to feel toward the hypocrisy of their Communist overlords. He recalled how a forerunner of Marx:

> . . . charmingly foretold
> that lemonade would flow in seas.
> Does it not flow?
> They drink sea-water,
> crying
> "lemonade"
> returning home secretly
> to vomit.

These were ominous rumblings. They can be read in retrospect as harbingers of the great upheavals in Poland and Hungary. However, the problem of rising expectations was a common problem throughout all the lands which Stalin had ruled. Indeed, popular expectations proved far in front of the policies of the reactionary regimes administering Stalin's colonial empire.

A Problem with the Outside World

Throughout all their troubles, Communist politicians have to continue believing that they are riding the wave of the future. The expectation of the Communists continues to be, as Khrushchev recently put it, that "we will bury you," – the "you" being the Free World. Nevertheless, Khrushchev appears to have concluded that Stalin's policies had ceased to be profitable; that, so to speak, our "burial," the predicted doom of capitalistic society, was being unnecessarily delayed.

To shift the metaphor a little, Stalin had been piled up on the line of scrimmage in Korea, as he had been earlier in Greece and Berlin. The new quarterback was deciding that instead of continuing to run line bucks, he should try a few end runs, reverses, and forward passes to test the enemy's secondary. Ac-

cordingly, the Soviet leaders finally agreed to a truce in Korea and took a compromise settlement in Indo-China.

When menacing threats of the Stalinist variety failed to prevent a continued growth in free world unity – evidenced by the further consolidation of the North Atlantic Treaty Organization and the adherence of West Germany – the pressure increased for drastically new tactics.

The Smiles Campaign of 1955

Thus, beginning in the late spring of 1955, the Soviet leaders launched their famous "smiles" campaign. In a remarkable series of policy reversals, they sought to dispel the evil image that the world had acquired of the U.S.S.R. and to win new friends and the ability to influence people abroad.

They agreed to an Austrian peace treaty; began to court Tito with an elite pilgrimage to Belgrade; relinquished their Porkkala base in Finland; and struck friendly poses – with Molotov waving a cowboy hat to American photographers and Khrushchev and Bulganin posing smilingly at the Summit Conference at Geneva.

In a second round of activity later in the year, the Soviet leaders began to deliver economic and military aid to non-Communist states; stepped up their public relations campaign with a trip to India and Burma; and stopped their monotonous vetoing of new members' applications to the United Nations.

The Soviets seemed to be making some progress with their new policy as 1955 went into history – even though their stand at the Foreign Ministers Conference in the autumn of 1955 made it clear that they did not intend to budge on basic international issues.

As it turned out, however, these smiles and concessions may have cost the Soviet leaders dearly; for, if they did mislead some people abroad, these actions continued to feed rising expectations in the far-flung Soviet empire.

The Two Great Events of 1956

Two great events in 1956, deeply affecting the Communist world, followed from the new Soviet domestic and foreign policies. The first was the attempt to persuade the leading communists in the U.S.S.R. and the satellites that the Soviet leaders had really broken with the dreadful past of the Stalin regime. The second was the attempt by Poland and Hungary to secure the freedoms which they felt were implicitly being promised them by Moscow.

Although Stalin's heirs had downgraded his importance fairly consistently since his death, Khrushchev's secret revelation of Stalin's crimes at the Twentieth Party Congress in February, 1956, represented a real turning point. These revelations destroyed the myth of infallibility of the Soviet system and its leaders. It was this belief in infallibility, which – however wrong – had inspired the faithful and given them the courage to sacrifice everything, including common sense and their very lives to advance the cause of Communism.

F. S. Lincoln, '22

Silhouetted against a burst of light is this rugged transmission tower of the Long Island Lighting Company in Port Washington, Long Island, New York. Power is conveyed from the plant at Glenwood Landing, near Glen Cove, New York, on Long Island.

Many questions – including the obvious one of "where were you, when all this was going on? – continue to be asked in the Soviet Union. Stalin's heirs had been morally compromised. The ideological foundations of this secular religion had been seriously shaken.

The circumstances surrounding the Khrushchev secret speech remain a mystery to this day. It was delivered at an unexpectedly summoned meeting of the Twentieth Party Congress attended by the 1,400 members from the U.S.S.R., but with the exclusion of visitors and delegates from the rest of the Communist world. Apparently it was felt that it was too heady medicine for the Soviet people, since the secret speech has never been published in the U.S.S.R. and only small parts of it have been allowed to creep out in the Soviet press, though copies of the speech were distributed among Soviet and satellite leaders.

It is hard to understand the Kremlin's apparent failure to assess accurately the damage to their position from the publicity which the speech would eventually receive. Some very impelling domestic reason must have made them take the calculated risk they assumed. Possibly they felt that such a thorough denunciation was required if initiative was to be liberated from the pall of fear at home, and if the image of the U.S.S.R. abroad was to be brightened.

The second event unsettling the Communist world in 1956 was, of course, the uprising in Hungary and Poland. When the Soviet leaders made their peace with Tito in June, 1955, they implicitly recognized, as Stalin never had, that genuinely different national paths were permissible within the Communist world. This idea was given some encouragement at the Twentieth Party Congress, which urged Communist Parties to use different, perhaps peaceful, rather than violent, means in seeking to gain power in non-Communist states. During the state visit of Tito to Moscow last June, the Soviet leaders formally recognized the validity of different paths of socialist development. But no sooner had they done this, than

the people in Poland and Hungary began to demand the right to determine their own destinies. Hardly had Tito returned home, when the workers in Poznan rose up to demand "bread and freedom."

The contagion spread to Warsaw in spontaneous meetings of workers and others who demanded an end to Soviet rule. In Hungary the people went even further in their assertion of complete independence of Moscow.

Throughout the summer Soviet policy zigged and zagged. When they were confronted with the events of late October, the Soviet leaders acquiesced reluctantly to some important changes in Poland, and temporarily appeared to do the same in Hungary before falling back on cruel repression. Through it all, the Soviet Union was discredited internationally; and no non-Communist was left to justify the savage slaughter of the heroic Hungarian people. Small nations in Asia, which are special targets for Communist blandishments, recognized the moral of Hungary; and young countries like Burma, Nepal, and Laos voted for condemnation of the Soviet Union.

In the face of these events, the Khrushchev position of trying to take bits and pieces of both a Stalinist and a non-Stalinist policy became increasingly untenable. If the Soviet leaders want to increase productivity and initiative they have to lift controls still further. If they want to improve their reputation abroad, they cannot continue to act as they are doing in Hungary. But, if they go too far in conciliating the people, they fear for their own positions.

Stirrings in the U.S.S.R.

There are stirrings in the U.S.S.R. as well as the satellites. Pressures for change appear to be coming from industrial managers and professional classes, who seem anxious to gain a greater share in running the economy. These groups appear to have increased their responsibility at the expense of professional party administrators in the recent reshuffling of the planning apparatus.

Perhaps even more disturbing to the Soviet regime are the rumblings of discontent which involve the very groups which Communism claims to favor: the workers and the students.

From the workers in the U.S.S.R. there have been growing indications of discontent in the past year, including several strikes and strike attempts, and demands to know more about the patterns of worker administration and control which have come into being in the Polish workers' councils.

Even more important, perhaps, is the increasing unrest among the students; which has been evidenced in riotous meetings and illegal handbill-type journals. The regime has staked much on its appeal to youth and the "new Soviet intelligentsia" which it hoped years of careful indoctrination would produce. But it has found that, in educating large numbers of youths to fill the positions required for the administration of a large modern state, it has taught people to think and ask embarrassing questions for themselves.

The youth in the Soviet Union are suffering from boredom with the drabness of their system. This discontent cannot very logically be dismissed as a "holdover from the past"; and the regime cannot dismiss it all as "hooliganism" – the Soviet version of juvenile delinquency.

Student unrest in the U.S.S.R., like recent events in Poland and Hungary, shows what many of us seem to have forgotten: that the love of freedom has deep roots. The bravery of the youth in Budapest, who had known only totalitarian rule, serves as a reminder that modern weapons do not provide the final answer to moral forces.

There are numerous signs in Soviet intellectual life that this human desire for individual integrity and free expression is making itself felt. The major Soviet journals in the fields of history, philosophy, and literature have all come under official Communist Party censure recently for deviations from the party line. There has been a revival of interest in long-neglected writers including Dostoevskii, whose major writings had been taboo under Stalin. Probably the most widely discussed single book in Russia today is a new novel with the distinctly non-Communist title of *Not by Bread Alone*.

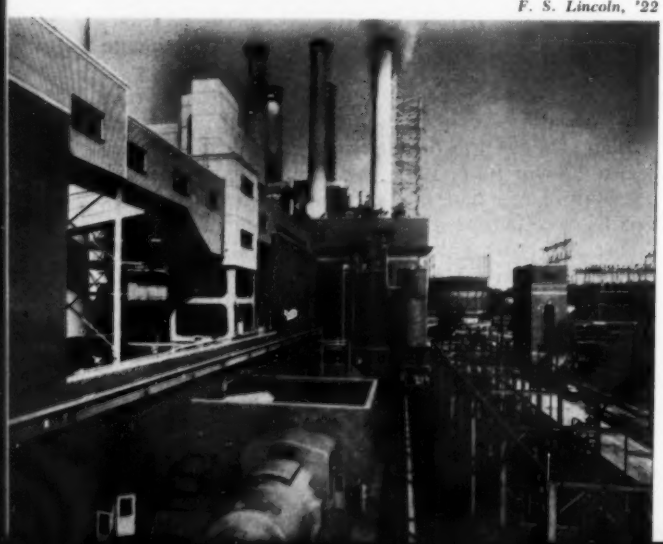
The hero of this novel is a persecuted inventor who succeeds not because, but in spite of, the system. A true individualist, he refuses to be bought off at the end by the very men who had sent him to Siberia on trumped-up charges. He hangs on them the label of "*meshchanskii* (middle class, philistine) communist," thus bringing back to the Russian vocabulary a traditional adjective of abuse from Tsarist times.

There is no pattern to tell us precisely how this intellectual ferment may affect the political development of a modern totalitarian and technocratic state. But it is doubtful indeed that these pressures for change can be satisfied merely by Khrushchev's combination of limited reforms and exhortations to observe party discipline. In particular, the disaffec

(*Continued on page 322*)

Symbolic of the American system of free enterprise and individual initiative is the power plant at Glenwood Landing, Long Island, whose operation and maintenance is dependent on the technological and engineering skills of men who have been permitted a freedom of choice in their education and later in their industrial pursuits.

F. S. Lincoln, '22



Technology Shapes Our Future

An inherent characteristic of technology and professional management is that they impose upon society a relentless requirement for more skill, talent, and breadth of understanding

by JAMES R. KILLIAN, JR.

The social changes we are witnessing in the world today have been aptly described as the "revolution of rising expectations." In the United States, but more particularly in the "have-not" or less industrially developed parts of the world, there is a consuming desire to achieve a higher standard of living and a better life.

This revolution of rising expectations stems in great measure from technology – from the industrial advance in Europe, America, and now Russia, and from the evidence that science has the capacity to create new wealth from nature as exemplified in these highly industrialized societies. Rising expectations are a natural reaction to the accelerating, on-rushing stream of modern technology – and I define technology as the application of science to useful ends, whether it be for curing disease, or for building a better environment, or for creating a new industrial product.

It is this on-rushing, exponential, rising-expectation characteristic of our present-day technology which is one of the most striking features of our world today. Everywhere we see the transforming effects of this rate of change phenomena on people, their way of life, their outlook and hopes, their standard of living.

Our familiarity with the indices of change hardly reduces our fascination in what they report. Recall, for example, what is happening to the length of our days and the numbers of the family of man. Thanks to better medicine and better environment, as George R. Harrison, Dean of the School of Science, has pointed out, every baby born today, on the average, will have twice as many days of life as a baby born at the time of the birth of our country. More years have been added to our life since I was born than during the preceding thousand years.

It has been estimated that the world's population 200 years ago totaled about 700,000,000. The estimate for today places it in excess of two and a half billion, and for 1980, a total has been projected of over three and a half billion. Today about 34,000,000 people are added to the population of the world every year, and the rate of increase seems to go up every year. The population of the United States, it is estimated, will increase 55,000,000 over the next 20 years.

Recall also our accelerating use of energy. Professor Harrison Brown has estimated that between 1900 and 1950, the U.S. energy demand rose nearly 20 per cent every 10 years, that in the years 1940–1950, it increased 50 per cent, that by 1975 it may well be 60 per cent or more above 1950. Another forecast of energy requirements concludes that in 2050, the annual power input required by the world may be about 30 times what it is now.

Along with this unexampled growth in the use of energy is an equally unexampled use of industrial raw materials, which in 1950 had grown to 18 tons for every man, woman, and child in the United States. This represents quite a lot of material to shovel!

Of course our energy demand is not unrelated to our increasing productivity and standard of living, and both are affected by technology. In the past three years, for example, the productivity per man-hour has risen from 3 to about 5 per cent, and the nation has achieved a current rate of productivity equivalent to a gross national product of over $400 billion – a level achieved much earlier than was predicted.

However illuminating and confirmatory such statistical evidence may be, we do not require a statistical abstract to show the changes we are experiencing. We do need to look behind the figures and the experiences to understand the nature of the changes and to try to see where they may be leading us. In a recent article, Eugene Holman aptly described our material progress as a stairway of advancement with progressively higher risers and narrower treads. Some observers are speculating as to whether our long ascent up this stairway is lifting our society to a new upper story of living; whether, in other words, our society may be approaching the "threshold of abundance" – a transformation of new embodiment, representing a new order of creativity, when man can achieve a new level of fulfillment for himself, and the earth be made to yield a sufficiency for all its people. Still others liken the advancement of our society to pulling out a sticky drawer. We pull at one corner only to have it stick on the other side, but as we alternate pulls, it comes out, giving on one side or the other. All of us recognize the possibility of our progress getting stuck at one corner from time to time, but most of us believe that it can be unstuck – provided we do not suffer the total catastrophe of total nuclear war.

I do not suggest that we have any warranty, expressed or implied, that progress is inevitable or immutable; I only describe the long-standing American belief that progress, even though it goes by fits and starts, is an achievable and worthy goal. I reflect my

Raymond E. Harrison

The world's population was something like 700,000,000 in April, 1775, when the original of this reconstructed bridge at Concord, Mass., was the scene of the "shot heard 'round the world."

own intuitive belief that man has the capacity greatly to improve himself and his society. I still bet on the "miraculous inventiveness of man" gaining on his inveterate cussedness.

There are thoughtful people today who challenge this optimistic view. We hear voices of doubt, warning, and pessimism, decrying or questioning the whole concept of progress. The increased currency of such phrases as "the illusion of progress" reflects an array of deeply felt attitudes challenging the concept of progress and a too great reliance on reason. Such other phrases as "the corrosive effect of materialism," "the self-destroying mediocrity of the machine," reflect another kind of attitude which still sees science and technology as possibly dangerous if not downright inimicable to the dignity and spirit of man. In mentioning these attitudes of doubt and pessimism, it is not my purpose, nor have I the competence, to debate the philosophical considerations on which they rest. My purpose, rather, is to express my contrasting faith that we can continue to draw the blueprints of a still greater society and that we can direct our advancing technology toward the realization of those plans. My purpose is to stress the importance of those aspects of technology which augment the quality as well as the quantity of life and things, which encourage individuality in the midst of standardization, which enhance man's excellence and dignity as well as his productivity. I wish to challenge the doctrine that our industrial technology leads only to the mediocrity of the mass and stultifying standardization.

Let me illustrate these opportunities and responsibilities of science and technology, selecting two out of many possible examples. I take first the impact and promise of that array of machines and concepts which we popularly group and debate under the loose term "automation." Second I wish to stress the importance of recognizing the liberal, humanistic values of science.

There is understandable concern that the new phase of the industrial revolution represented by machines controlling machines should be managed so that people will be helped rather than hurt, so that there will be more jobs rather than fewer, a further elevation of man's values, standards, and aims rather than more standardization. We must not assume that automation will be automatically benign. It will be so only if we have the wit and gumption to use it benignly. We must plan carefully to insure that workers of less than average abilities do not suffer as automation puts a premium on skills. I think the evidence is overwhelming, however, that the social desirable and humane end can be achieved, and that local and temporary dislocations, which increased mechanization sometimes causes, can be minimized by careful, responsible managerial planning. Certainly we have every reason to expect that the use of machines to control machines can help further to underwrite the productivity upon which our dynamic economy so greatly depends.

These frequently expressed conclusions about the meaning of automation, however, are by no means the whole story; they do not adequately emphasize some of its remarkable qualitative implications. For example, automation will require more and more skilled labor, will reduce the necessity for dull and repetitive forms of labor. It will call for more education at many levels, both sub-professional and professional. The constellation of concepts which are represented by computing machines and the terms "cybernetics" or "information theory" hold the promise of powerful new tools for use in such fields as economics, language, psychology, medicine, and management. Cybernetics may thus build new bridges between the domain of science and the domains of the humanities and social science. By making possible quantitative planning and decision-making in management, computing machines and other data-processing techniques will help to reduce the present high degree of empiricism and downright guessing. Not the least important of their uses may be the new light they may throw on the functioning of the human mind and nervous system. To use the figurative terms of Jacob Bronowski, machines have evolved in two directions, the one toward muscle or strength, the other toward brain or foresight, and we are now in the flood tide of this last group of machines which help to make the human brain more powerful and which hold the promise of helping us break through size and mass and chaos to perceive otherwise undetected patterns and to make more discriminating choices.

These are important qualitative effects; their achievement can help us offset the increasing bigness of our society and its organizations by giving us the better communication which will make size more humane, more controllable, more consonant with the scale of the individual.

Here is a suggestion of how science and technology can help to counteract the grossness of life, to increase our powers of large-scale co-ordination, to refine our quantitative judgments and perceptions so that we can further refine our qualitative judgments. If technology inevitably leads to a greater scale of

organization, greater quantities, higher speeds, more standardization, it also helps to provide powerful new means for enabling man to control these effects and to adapt them to benign use. To keep our environment humane, to make our economy sufficient for the needs of all its people, to make our highways and airways safe, to reconstruct our cities where they have become blighted or strangled, to plan farsightedly their growth and change, to provide adequately for millions of new population in our cities — here indeed are immense national tasks of the highest priority, tasks in which boldness of planning and management must join an audacious technology if we are to triumph over ugliness and meanness of environment and to achieve a new benignity of living.

Always we come back to man himself, even when we discuss the dramatic possibilities of automation. This was happily illustrated by the following anecdote, told recently by J. R. Bright at the Harvard Business School. A test pilot visited a large plant to see the latest concepts in automatic controls. "Young man," said one of the design engineers, "your days are numbered. We've got a new control coming along that will run your plane from the ground. You'd better hunt yourself a nice soft job elsewhere."

"I'm not so sure about that," replied the pilot. "Have you come up with a control mechanism that weighs less than 150 pounds; has 5 senses, 6 degrees of freedom; one that is completely self-contained, self-powered, and self-lubricated? Not only that, have you come up with a control device that is so readily and easily produced by inexperienced labor?"

My second illustration of the importance of qualitative and humanistic factors in our modern technology is to be found in our attitude toward science and scientists. The belief that science is wholly materialistic and vocational, that it undercuts the dignity and individuality of man, that it contributes only to the quantification and not the quality of our society, are beliefs all too frequently held today.

The weight of the evidence seems to show that much of our liberal education — and teacher education — in the United States has largely failed in making science a meaningful part of its education. As a result, much of our general education has failed to achieve any deep relevance to contemporary life or to give adequate insight into how it is being shaped by science and technology. Our modern liberal education, which so appropriately exalts the achievements of ancient Greece, frequently forgets that the Greeks made no real cultural distinction between science and the humanities. It frequently forgets that the motto over the door of Plato's Academy proclaimed, in effect, that mathematics was required.

The misapprehension about science in the public mind may be, and probably is, one of the principal reasons why we have too few students studying for scientific careers or too few competent teachers to teach science.

But what, you ask, is the real character of pure science? The best description I know comes not from a scientist but from a philosopher — Charles Frankel of Columbia University. Science, says Professor Frankel in his eloquent book, *The Case for Modern Man*, "is an example par excellence of a liberal art — a deliberate, selective reordering of experience, which releases men from the narrowness and urgency of their routine affairs, carries them beyond the limitations and accidents of their lives, and makes it possible for their commerce with the world to have scope, order, and systematic consequences. It has been used as an instrument of . . . war, but its primary function is more humane and, as it were, aes-

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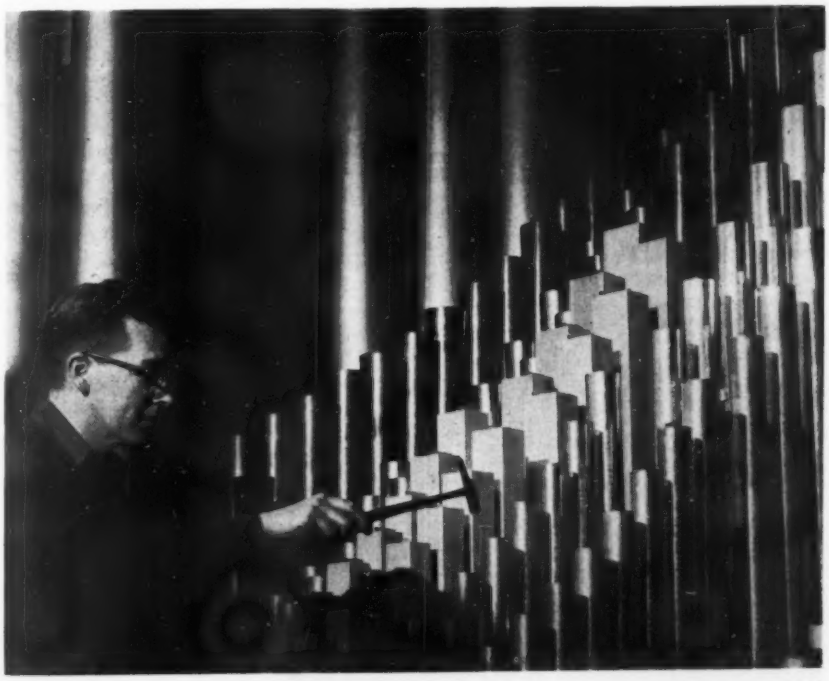


"My purpose is to stress the importance of those aspects of technology which augment the quality as well as the quantity of life and things, which encourage individuality . . . which enhance man's excellence and dignity as well as his productivity. I wish to challenge the doctrine that our industrial technology leads only to the mediocrity of the mass and stultifying standardization." — Dr. Killian.

M.I.T. Photo

Lee Gillette—Tulsa Tribune

▲ *President Killian expresses his thanks to Paul Pitts (right) and other members of the Osage Tribal Council for conferring honorary membership upon him.*

▲ *Theodore T. Miller, '22, (left) President of the Alumni Association, and William R. Holway, '15, (right) who received award for distinguished service.*

▼ *William J. Sherry, '21, (left) who headed the Tulsa Conference, with Jerrold R. Zacharias, (right) Professor of Physics and popular conference speaker.*

Regiona

"M.I.T. Day" in Oklahoma draws 1,200 t Tulsa Conference where Alumni win award and Dr. Killian is inducted into Osage Natio

M.I.T.'s 9th Regional Alumni Conference in Tuls on February 2 was the largest conference of this kind ever held. Twelve hundred Alumni, industrialists, educators, and students participated. Sponsored by the M.I.T. Club of Oklahoma, as a salute to the state's golden jubilee, it was an event that Tulsa and M.I.T. will long remember. Governor Raymond Gary proclaimed that Saturday as "M.I.T. Day" in Oklahoma. On the eve of the conference, James R. Killian, Jr., '26, President of M.I.T., was officially adopted as an honorary member of the Osage Tribal Nation. At the final dinner, the M.I.T. Alumni Association presented awards for distinguished service to two of Tulsa's leading citizens, William R. Holway, '15, and William J. Sherry, '21.

So many persons wanted to hear Jerrold R. Zacharias, Professor of Physics, and John G. Trump, '33, Professor of Electrical Engineering, discuss, respectively, the frontiers of physics and the applications of ionizing radiation at the morning session, and Robert R. Shrock, Professor of Geology, and E. P. Brooks, '17, Dean of the School of Industrial Management, speak, respectively, on geological and on industrial problems at the afternoon session, that these meetings had to be moved from the Hotel Mayo to a former theater, two blocks away, now known as the Cimarron Ballroom. For the luncheon meeting, at which Warren K. Lewis, '05, Professor of Chemical Engineering, Emeritus, spoke, and the dinner, at which George R. Harrison, Dean of the School of Science, and President Killian spoke, the Mayo's largest dining room was tightly filled.

Three university presidents — George L. Cross of the University of Oklahoma, Oliver S. Wilham of Oklahoma Agricultural and Mechanical College, and Clarence I. Pontius of the University of Tulsa — participated in the conference. Seven justices of the Oklahoma Supreme Court, and so many prominent business and professional men that it is impossible to list them all, attended the conference. John A. Meggison, '05, an electrical engineer, was there from Galena, Kansas, to see Professor Lewis for the first time since they were classmates. The 18 M.I.T. men who went to Tulsa from Cambridge had a busy, delightful day.

Chief Paul Pitts of the Osage Nation presented the feathered headgear and blanket of an Osage to Dr. Killian at the pre-conference dinner in the Tulsa Club. Dr. Killian was honored — "in recognition of his internationally renowned ability as a leader in

(*Concluded on page 318*)

Conferences

Mid-America Conference in Chicago deals with nuclear energy, education, and management. Dulles discusses evolution in communism.

CHICAGO greeted the 1957 Mid-America Conference in a way that left the Institute — and the M.I.T. Club of Chicago — with many new warm and responsive friends in the Windy City. The conference on Technology for Mid-America was held at the Sherman Hotel in Chicago on February 16, and more than 450 visitors came from Illinois, Michigan, Ohio, Indiana, Iowa, Missouri, and Wisconsin.

James R. Killian, Jr., '26, President of the Institute, led the Cambridge delegation. He spoke briefly at the banquet, emphasizing the nation's growing need for qualified professional people and the urgent necessity to recognize, foster, and bring to their full capabilities the most gifted of our young people.

Earlier, at the morning session, Walter G. Whitman, '17, Head of the Chemical Engineering Department, told the regional conference audience that nuclear engineering is "the new frontier" for American universities. At least 2,000 nuclear engineers are now needed every year, but less than 200 graduate.

M.I.T.'s response to this need is fourfold, said Dr. Whitman: (1) Five years ago the Institute inaugurated a graduate program in nuclear engineering, under the direction of Manson Benedict, '32, Professor of Nuclear Engineering; M.I.T. has since developed a strong core of classroom instruction and thesis research, and 75 students are currently enrolled; (2) early in 1958 the Institute will complete construction of a nuclear reactor designed for teaching and for research in a wide variety of scientific fields; (3) early in February, the Institute began instruction in modern instrumentation in a laboratory which includes radiation sources, detecting devices, and a wide variety of other instruments; (4) students in nuclear engineering will build, during the spring, an eight-foot graphite sub-critical pile for laboratory instruction in reactor engineering.

E. P. Brooks, '17, Dean of the School of Industrial Management, returned to Chicago as a businessman-turned-educator, to tell the conference during the afternoon session what educators foresee for business management in the decades ahead.

"Management of industrial enterprises has become a high calling," he said, and its future problems will call for "industrial statesmanship" of high order.

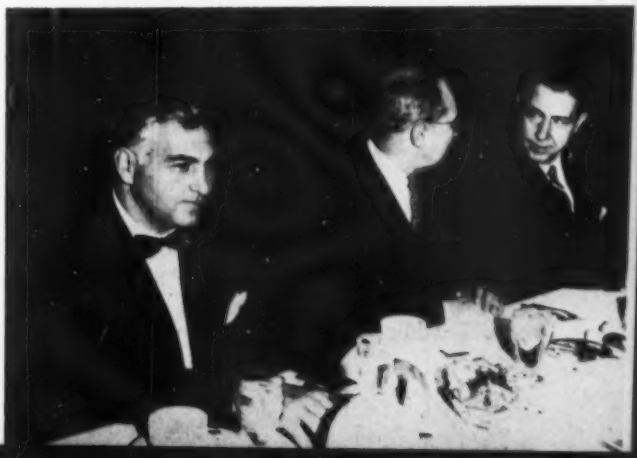
At the morning session, John E. Arnold, '40, Associate Professor of Mechanical Engineering at the Institute, described and illustrated how new ways of looking at things may help all engineers to be more imaginative and creative.

(*Concluded on page 320*)

Jack Curran, Rialto Service Company

▲ *Among those present at the banquet of the Mid-America Conference were (left to right): Major Lenox R. Lohr, Head of Chicago's Museum of Science and Industry; James M. Barker, '07, Chairman of Board, Allstate Insurance Company; President Killian; and Allen W. Dulles, Director, Central Intelligence Agency.*

▲ *At the head table at the luncheon were (left to right) Philip L. Coleman, '23, who presided; Dwight K. Taylor, '26, President, M.I.T. Club of Chicago; Robert M. Kimball, '33, Secretary of M.I.T.; John R. Kirkpatrick, '48, a member of the Conference Committee.* ▼ *Also at the head table during the luncheon were (in reading order): Alfred S. Alschuler, '35, (architect), of the M.I.T. Club of Chicago; John W. Barriger, '21, 3d, railway executive; and President Killian.*



Lock, Stock, and Barrel

It was no flash in the pan concept that led to the construction of new guns from parts of old during a frugal period of a third of a century

by FREDERIC W. NORDSIEK

THE "bargains" of war surplus are so much a part of the contemporary scene that it is hard to believe that Uncle Sam was once so frugal he was able to bridge a whole era of firearms development – the transition from muzzle-loading muskets to breech-loading metallic cartridge rifles – by using parts from the old guns to make new ones.

Why is war surplus ever with us? The wasteful exigencies of war demand that military supplies of all sorts be abundantly available at widely scattered points. When hostilities suddenly cease, much of this war material, produced in huge quantities, becomes useless and is dumped on the civilian market at disaster prices. Such bargains have their limitations, for military goods are seldom entirely suited to civilian use. Also the purchaser must realize that, as a taxpayer, he has already compensated for the difference between its original value and the surplus purchase price.

Bargain Bazaar

Today surplus materials from World War II glut the market. Sheepskin-lined leather pants that cost Uncle Sam $25.00 for Air Force personnel may be had now for $5.98. The subtleties of modern warfare have led to the current availability of many surplus bargains in the electronics and optics fields. To cite examples, radio transmitters costing $1,500 during hostilities can be purchased for $39.95; aircraft receivers with tubes have sold for less than $5.00 rather than $75; gunsights that cost about $100 may be bought for $4.75; sextants for which the government paid $220 sell for $22.50; and a $21,000 computing instrument used in fire control is yours for a mere $150. As a rule, items of this nature are useful to civilians, if at all, only to be disassembled and used as a source of parts.

But currently available military surplus materials are not limited to those from World War II; dealers are still offering choice items from the Civil War! An example of old-time war surplus equipment will serve to illustrate another reason why such items are ever plentiful – the rapid change in methods of waging war, and the consequent speedy obsolescence of weapons and materials. Cavalry last saw significant service during the Spanish-American War, yet you may still purchase all the cavalry equipment you want, for next to nothing. Thus the "boot," a leather and brass affair that was attached to the mounted trooper's saddle to hold his carbine, cost more than $6.00 in the currency of 1898, but now sells for only $0.40 even in today's devalued money.

Evolution of the Rifle

But no change in a fundamental tool of war has ever been more revolutionary than the development, during the last half of the Nineteenth Century, of musket into rifle. For more than two centuries smoothbore, muzzle-loading, flintlock muskets served all firearm needs, military and civilian. The flintlock system was invented about 1630; as late as 1844 the United States Armory at Springfield, Mass., was still making flintlock muskets. The Springfield Armory was established toward the end of the Eighteenth Century, and in 1795 began the production of the flintlock musket shown in Fig. 1. The last flintlock, made there in the year 1844, differed from the prototype only in minor details.

Rifling of gun barrels was invented in 1547; but rifling* increases the accuracy of a gun only if the bullet fits the barrel snugly, and for military purposes a snug-fitting bullet took much too long to ram home. A workable breech-loading mechanism was patented in England in 1776; but until the advent of the metallic cartridge, all breech-loading devices dissipated so much of the force of the discharge through leakage at the breech as to be impractical.

The Percussion System

After development of the flintlock in the Seventeenth Century, the first invention to have significant impact on military firearms was discovery of the percussion system in 1807. To explode the powder charge, this system employs a detonating cap, essentially similar to that used in a child's toy cap pistol.

With adoption of the percussion system, the government was "stuck" with large quantities of flints; these are still on sale, by a New York surplus dealer, for $1.00 a dozen.

By 1841, the percussion system had evolved to a sufficient degree of effectiveness that the United States Government formally adopted this system in place of the flintlock, although the Springfield Armory

*Rifling is the cutting of spiral grooves running the length of the interior of a gun barrel. The bullet fits so tightly that the ridges between the grooves inside the barrel press into it. Therefore, the bullet in passing through the barrel is given a rapid spinning motion in addition to its forward motion. Acting on the principle of the gyroscope, this spin holds the bullet to a true course.

continued to make flintlocks for three years more. A percussion gun, made for the U.S. Army by the Springfield Armory, is shown in Fig. 2. This is the 1863 model, produced toward the end of the percussion era.

Metallic Cartridges

The next, and in a sense the ultimate, advance was the perfection of a center-fire metallic cartridge in 1860. By this invention the older idea of rifling of gun barrels was made really effective, and breech-loading became practical. In 1866, only two and a half decades after percussion guns came into use, the Springfield Armory produced a metallic breechloader, which is illustrated in Fig. 3.

Thus Springfield made its last flintlock in 1844; its first metallic cartridge breechloader in 1866. Just 22 years had seen this great change in a basic tool of warfare.

Waste Not — Want Not

The flints, already mentioned, were about the only major surplus items resulting from the fast-paced changes in the infantry's fundamental weapon. The guns on hand, when each major change occurred, were boldly altered to the new design. This could be done for two reasons: first, because Eli Whitney of New Haven, Conn., had introduced interchangeable gun parts in 1798 (as a means for mass production); and second, because the lock (the only mechanical part of these old guns) did not really change in design from the Seventeenth Century, when the flintlock came in, until the end of the Nineteenth Century, when repeating rifles replaced single-shot breechloaders.

The figure of speech, "lock, stock, and barrel," derives from the three classic parts of a musket. The barrel was always merely a metal tube closed at one end; the stock was always simply a wooden handle to facilitate holding and aiming the weapon. The lock was the salient mechanical feature. It provided a hammer, arranged to be released by a trigger, and actuated by a powerful spring. In the flintlocks this hammer drove a flint against a steel plate, to strike a spark. In the percussion guns, the hammer descended upon a nipple, to explode a detonating cap. In the early breechloaders, the hammer struck a firing pin, driving it into a primer set in the base of a metallic cartridge.

How Old Guns Worked

The lock of a Revolutionary War flintlock musket is illustrated in Fig. 4. The lock plate, supporting the

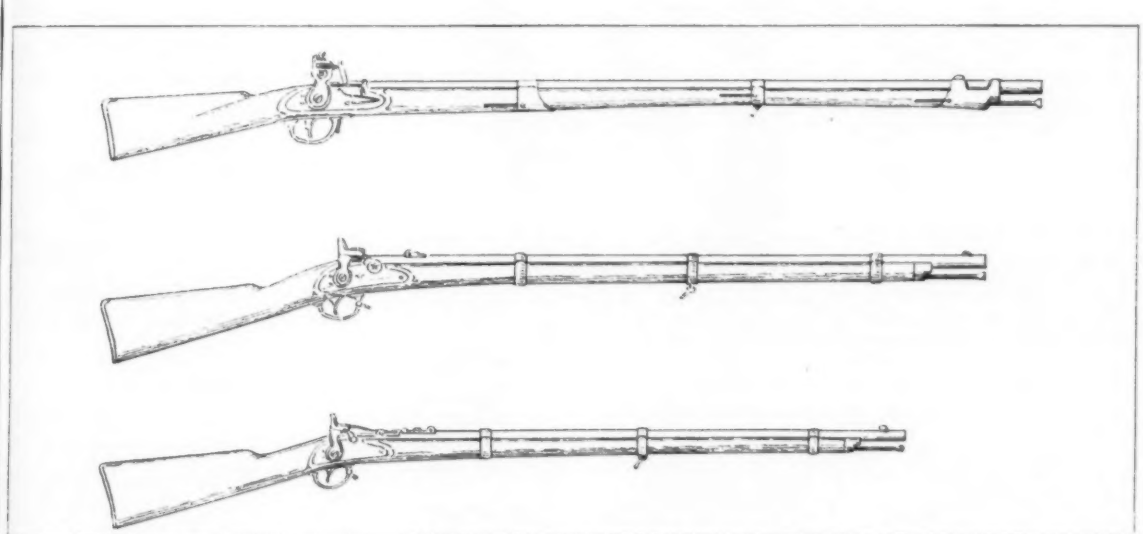
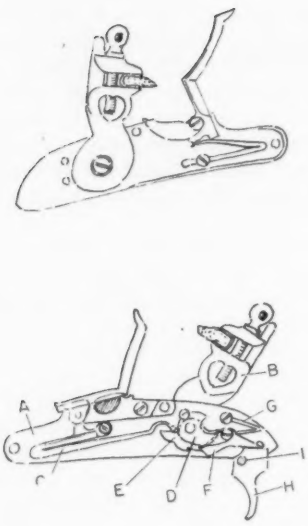


Fig. 1. (Top) The first gun made at the Springfield, Mass., Armory after it opened in 1795. This muzzle-loader was a smoothbore flintlock, firing a 69-caliber ball; it measured five feet overall. Such long barrels were used to gain maximum impetus from the slow-burning black powder, and also in the hope of directing the bullet with some degree of accuracy. But the loose-fitting bullet emerged from the unrifled barrel to pursue a course that was at best erratic. The soldier armed with this piece could be more sure of hitting his antagonist with a carefully thrown rock than with a shot from his musket.

Fig. 2. (Center) The first Springfield percussion guns were made by converting or "altering" the old 69-caliber flintlocks; such guns were issued to some militia regiments at the outbreak of the Civil War, and several mutinies occurred in protest. The 58-caliber percussion gun shown above was made at the Springfield Armory from the time the old flintlocks were used up, until the percussion system went out of use. These guns continued to be muzzle-loaders, but now the barrel was rifled instead of being smooth. Such guns cost the government $10.69; as collectors' items they now bring about $35.

Fig. 3. (Bottom) The single-shot, breach-loading rifle made for the U.S. Army by the Springfield Armory. A simple trap-door mechanism permits the insertion of a metallic cartridge into the rear of the barrel; such guns were made at Springfield from 1866 to 1890. Note how much this rifle looks like the Civil War muzzle-loading musket shown in Fig. 2. Many old musket parts were used to make the early breechloaders. Thus the writer owns an 1870 breechloader, caliber 50, made with the lock plate from a Civil War 58-Caliber muzzle-loader. As may be seen, the gun pictured above was equipped with a ramrod; tradition dictated that this accessory be retained, although it had no use whatsoever with the breechloader.

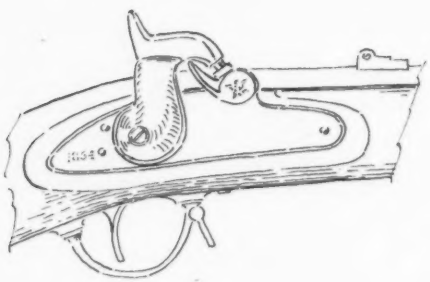


◄ *Fig. 4. Diagram of the lock of a Revolutionary War flint lock musket. With minor changes this lock was used on U.S. military rifles until the end of the Nineteenth Century.* (Top) Outside view, *looking from right side of the stock; gun has been discharged.* (Bottom) Inside view, *showing parts hidden in a recess in the stock. Hammer is cocked. To discharge the gun, the finger pressed backward on the trigger, in the direction of the horizontal. The trigger pivoted around the trigger screw, pressing upward against the sear, in the direction of the vertical. This pressure disengages the sear from a notch in the tumbler, allowing the hammer to fall.*

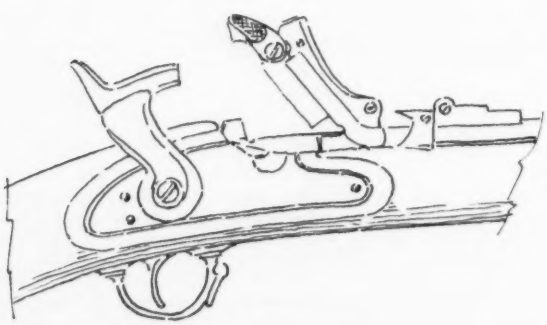
Key to principal parts: A – lock plate; B – hammer; C – mainspring; D – bridle; E – tumbler; F – sear; G – sear spring; H – trigger; I – trigger screw.

entire mechanism, was set in a recess on the right side of the stock; the trigger, as the diagram shows, worked upward through a vertical hole in the stock.

With only minor changes, this lock was part of the U.S. Army rifle until 1890. When the flintlock system became outmoded, the frizzen and pan and their appendages were eliminated, and the flint-holding hammer was replaced by one with a solid head, having a depression on its striking face to fit over the nipple that held the detonating cap as shown in Fig. 5. When this lock was transferred to breechloaders, the only change made was to grind the face of the hammer flat, to assure a good blow against the firing pin, as shown in Fig. 6.



▲ *Fig. 5. Outside view of a percussion lock. A nipple to hold a percussion cap has been put in place of the pan of the flintlock, and the flint hammer has been replaced with a solid hammer having a depression in its striking face to fit over the nipple.*



▲ *Fig. 6. Outside view of a breechloader lock. The percussion nipple has been removed, and the rear of the barrel fitted with a simple trap-door device for inserting the 50-caliber metallic cartridge. The face of the hammer has been ground flat to provide a good blow against the firing pin. This pin traverses the length of the trap door; when struck by the hammer it is driven into the primer, a detonating cap set into the center of the base of the cartridge.*

Interchangeable Parts

Fig. 7 shows how long a period of usefulness was enjoyed by some of the principal parts of the Ameri-

(Continued on page 308)

FIG. 7. INTERCHANGEABLE PARTS OF OLD GUNS

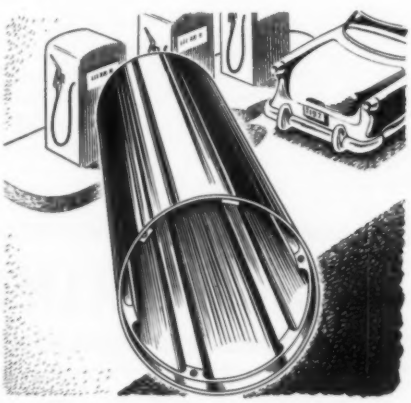
	58-Caliber Muzzle Loaders 1855–1864	50-Caliber Breech Loaders 1866–1870	45-Caliber Breech Loaders 1873–1890
LOCK PARTS			
Mainspring			
Bridle			
Bridle Screw			
Lock Plate			
STOCK PARTS			
Butt Plate and Screws			
Guard Bow and Parts			
Band Springs			
BARREL PARTS			
Front Sight			
Breech Screw			
Breech-loading Parts			
BAYONET AND PARTS			
Bayonet			
Bayonet Clasp Parts			

BUSINESS IN MOTION

To our Colleagues in American Business . . .

When you drive into a gasoline station and ask the attendant to, "Fill 'er up", you may not be aware of it, but in the storage tank beneath the concrete on which your car is standing there may be an electric motor and pump submerged in the gasoline. There is quite an interesting story about this explosion-proof motor.

The use of the positive displacement type of pumping unit in service station operation has presented vapor-lock problems to pump manufacturers for many years. And with the introduction of even more volatile gasoline, present pumping systems have become inoperative in some applications. The use of a submersible pumping unit in the gasoline storage tank therefore has become not only desirable but virtually a necessity.



In designing the pump motor for this type of unit a leading manufacturer had originally planned on using an aluminum casting for the stator, or outside shell of the motor. But when the design engineers considered the factors that would be encountered, and the symmetry of shape, it appeared that an aluminum extrusion might have advantages over a casting.

At this point the manufacturer recalled the numerous Revere copper and brass parts they had been using in their motors over the years, with the utmost satisfaction, and how Revere's T.A. (Technical Advisory) Service had often helped them with similar problems. The result was a huddle with a Revere Technical Advisor to discuss the various pros and cons of castings versus extrusions.

It was found that by using extrusions there would be no problem of porosity which is often present in the case of castings. Substantial savings in weight would also be made as the wall thickness of the stator shell could be reduced, and the only machining would be to the ribs on the inside of the tube. With an extrusion no machining of the outside of the tube is required, which would be necessary should a casting be used, while the smoother surface on the inside improves flow characteristics. This is an important factor in this particular pump motor since the fluid being pumped passes between the stator core and the extruded shell, while in the conventional submersible pump motor a double shell is used. Also, with the smooth surface of an extrusion, less horsepower is used to pump a given volume of fluid. The result was the hollow Revere Aluminum Extrusion you see sketched at left, measuring 13-9/16" long by 3-1/2" O.D.

Here you have still another example of Revere cooperating with the customer in selecting the right metal in the right form to do the best job with the greatest economy . . . be it aluminum, copper or any one of their alloys.

Not only the copper and brass industry but practically every industry you can name is able to cite similar instances. So we suggest that no matter what your suppliers ship you, it would be a good idea to take them into your confidence and see if you cannot make a better product at lower costs by specifying exactly the right materials.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue, New York 17, N. Y.

LOCK, STOCK, AND BARREL

(Continued from page 306)

can military rifle. Of the lock parts, the plates are of particular interest, because they were plainly marked with their dates and places of manufacture. These dates show, for example, that the 50-caliber breechloaders were made with lockplates from the old 58-caliber† percussion muzzle-loaders. An 1870 metallic cartridge Springfield rifle in the writer's collection bears an 1863 lock plate, taken from a gun like that shown in Fig. 2. As these 58-caliber muzzle-loaders were the principal weapons of the Civil War, and were in short supply throughout the conflict, the chances are that this very lock plate saw service in the field during the Civil War.

The mainspring and bridle are the lock parts with greatest longevity, and had useful lives extending over 35 years. In 1873, the bridle screw lost its usefulness with the advent of the 45-caliber breechloader, only because of the fact that the newer gun had a thinner lock plate, so that a shorter screw was needed.

†Caliber refers to the crossways diameter of the bullet in hundredths of an inch; thus the 50-caliber bullet used in the first breechloader was a half inch in diameter. The 69- and 58-caliber musket balls had these odd calibers because they were designated in terms of the number of balls per pound of lead. When the 50-caliber metallic cartridge came in, design in terms of diameter of the bullet was adopted, hence the neat even succession of 50, 45, and 30 calibers.

Although made of the finest black walnut the country could provide, the stocks of those old guns suffered sufficient battering in use that they were discarded when alterations were made. But several stock parts, made of steel, were used over and over. Notable among these are the butt plate, that covered the part of the stock held against the shoulder in firing, and the guard bow. This latter part is the one that encircles and protects the trigger. As Fig. 7 shows, these parts and their appendages were good over a span of more than 35 years.

The front sight, which also served as a stud to steady the bayonet, was the only barrel part that was uniform for all of these guns. But the breech screw (which was the plug that closed the rear of the barrel) and quite a few parts of the simple single-shot breech-loading mechanism, were interchangeable throughout the entire quarter of a century during which single-shot rifles were made for the United States Army.

The bayonets used on old guns were the angular type, familiar in pictures of the Revolutionary and Civil Wars. Except for brief experiments with other designs, the angular bayonets were standard U.S. Army equipment up until about 1892 when the now standard knife bayonet was adopted. As Fig. 7 shows, bayonets from the muzzle-loaders were used on the first breechloaders. Parts of the bayonet clasp, the device that holds the bayonet in place, spanned the entire 35-year interval from 1855 to 1890.

(Concluded on page 310)

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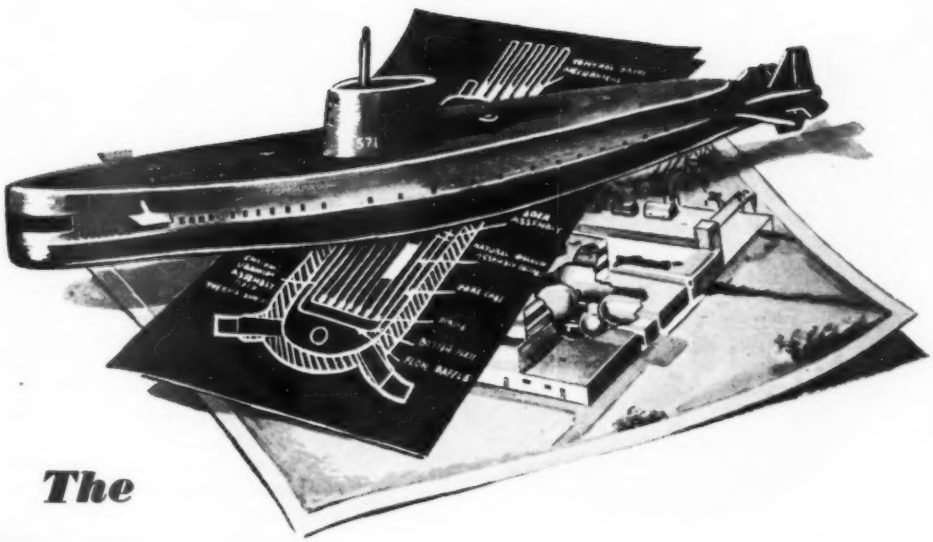

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LOCK, STOCK, AND BARREL

(*Concluded from page 308*)

The last decade of the Nineteenth Century marked a turning point in the American military rifle. As just noted, the knife bayonet replaced the traditional angular bayonet. In 1892 the Springfield Armory made its first repeating rifle; this was also the first weapon to use smokeless powder rather than black gunpowder.

Advent of the Repeater

At the same time the fourth, and to date final reduction in caliber occurred. The Revolutionary War flintlock shot a ball of 69 caliber, or 0.69 inch in diameter; Civil War percussion guns were 58 caliber. The first breechloaders were 50 caliber, and in 1873 were reduced to 45-caliber. With the advent of smokeless powder, a 30-caliber bullet was adopted, and is still standard. Smokeless powder also made possible a substantial shortening of the barrel, and hence of the total length of the gun. The 30-caliber repeaters have a barrel only two feet long, and an over-all length of but 43¼ inches. The 1795 flintlock shown in Fig. 1, was five feet long, and had a barrel 44½ inches in length. Hence the total length of 30-caliber repeaters is actually less than the barrel length of the old muzzle-loaders!

The major changes that have taken place in the development of firearms of the "shoulder arms" variety have been traced, from the Revolutionary War flintlocks to the modern breech-loading repeating rifles. That it was feasible to use pieces of the same design — and even the same identical parts — for repair and replacement throughout a period of as much as 35 years is a revealing commentary on our Nineteenth Century industrial economics. Today, with much better techniques of manufacture, better materials, and vastly improved methods of test and inspection, assembly operations do not reflect the provident use of resources that marked a more frugal era.

Part of the reason for this shift is that the advent of the repeating rifle ruled out the possibility of using old gun parts to make new firearms. The complexity of the repeating mechanism, the precise fitting of parts necessitated by the high pressures generated by smokeless powder, and the much greater variety of service conditions to which modern arms may be put, have made it impractical to employ such cannibalism as has been described. Thus passed an era of "alteration" — a period of utmost fascination for the firearms historian.

But doubtless other factors are also at work to mitigate against combining old with new. Today labor costs are at an all-time high, and it is cheaper to make new parts by automatic machinery than to hire the manual labor required to reclaim, restock, and re-use old parts. Then, too, we are not so thoroughly imbued with the need for economy as were our ancestors; we have been conditioned to accept obsolescence — and frequently discard machines in good operating condition merely for reasons of style. In the time of Benjamin Franklin, "waste not, want not," was a thoroughly good maxim to impart to the young. But somehow, in the Mid-Twentieth Century, we seem to have lost sight of this aim, "lock, stock, and barrel."

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TREND OF AFFAIRS

(*Concluded from page 291*)

In addition, two general points were made, of whose validity we are not yet certain, which are receiving careful consideration by the Department.

The first of these is the suggestion that freshman chemistry as now given is perhaps slanted too much toward physical chemistry and numerical problem-solving. It is possible that greater emphasis could appropriately be placed on questions of chemical structure and on organic chemistry. This raises the question as to what the ideal content of a course in freshman chemistry should be. If it can be said with validity that such a course should spread out before the student all facets of the science, so that he may decide intelligently whether or not chemistry is the profession to which he wishes to devote his life, then it would seem to follow that the freshman course should be as broad as it is possible to make it.

The second question was whether, with a necessarily fixed curriculum, sufficient opportunity existed to develop from among the young instructors the dedicated and enthusiastic teachers who would create, by their own personality, a desire in their students to follow their profession. Manifestly it is difficult for a young man whose primary interest is organic chemistry to do an enthusiastic job if the curriculum requires him to concentrate on physical chemistry and problem-solving. The necessity for inspired teaching is certainly obvious, and experience indicates that inspirational teaching produces real and tangible results. Apparently because of the teaching abilities of certain members of their chemistry departments, a few of the liberal arts colleges, for example, have produced consistently a greater proportional number of men going on for their Ph.D. degrees in chemistry than other institutions. It would seem that the more it is possible to "turn loose" young instructors to concentrate on those areas in which they are vitally interested, the more likely it is that inspired teaching will result.

Perhaps these two points are, to a considerable extent, interrelated. If, for example, the freshman chemistry curriculum were broadened to include in reasonable degree all facets of the science, it might follow automatically that the instructors, through being able to "ride their hobby" somewhat more actively, might more readily communicate some fraction of their own enthusiasm to their students.

It should be emphasized that the Visiting Committee has come to no final conclusion with respect to these questions. It is important at the moment only that they have been raised, and that they are being given full and careful consideration. For this reason we have no recommendations to present except to urge the importance of increasing the interest and attractiveness of freshman chemistry.

The report of the Visiting Committee on the Department of Chemistry was received for publication in The Review on October 25, 1956. The topics enumerated above were presented at the meeting of the M.I.T. Corporation on March 5, 1956.

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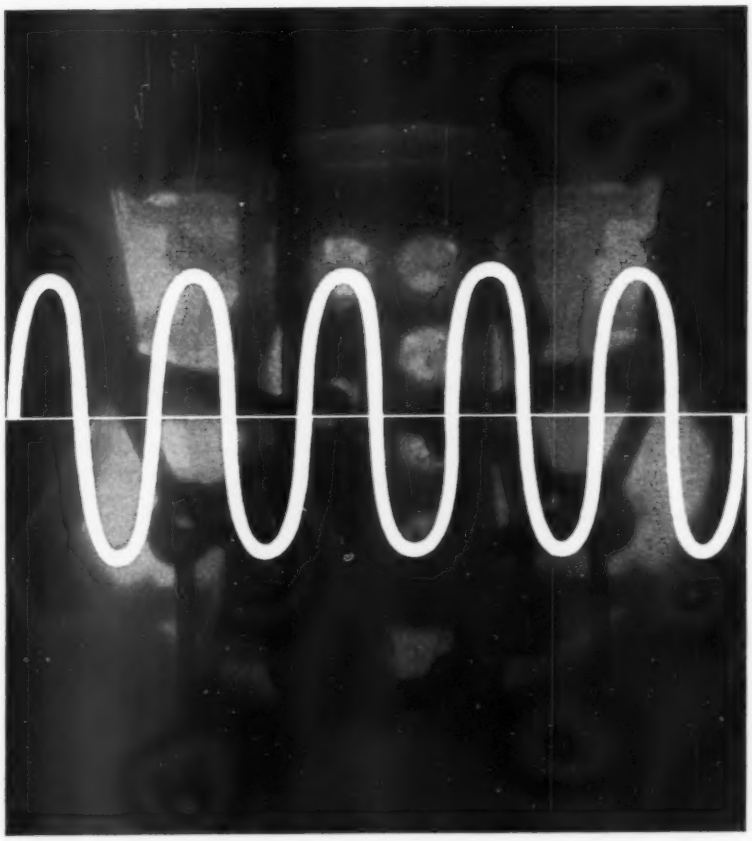

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TECHNOLOGY SHAPES OUR FUTURE

(*Continued from page 301*)

thetic. And its relation to practice is the relation of any fine and liberating art – it carries men beyond the foreground of their experience, and enlarges the dimensions of human choice by acquainting men with the alternative possibilities of things. Quite apart from its technological applications, it represents, to use an old philosophical expression, a 'final good' – something which has its own inner dynamism, goes its own way, and can give stability and direction to the rest of our lives."*

And to this description can be appropriately added the following observation of Warren Weaver of the Rockefeller Foundation. The facts, he said, "do not support the concept of science as some sort of super creed, magical and mysterious as it is all-powerful, arrogant from its successes, and avid to invade and conquer, one after another, all the fields of human activity and thought. This viewpoint does not justify the notion that science is so special as to be unique, as well as so curious as to be incomprehensible. This does not depict scientists as strange creatures who are in one sense so objective, judicial, and precise as to be incredible, and in another sense so apart from life as to be selfish and sinister.

"On the contrary, these descriptive comments picture science as the servant of man, not his master;

(*Concluded on page 316*)

*New York: Harper and Brothers, 1956.

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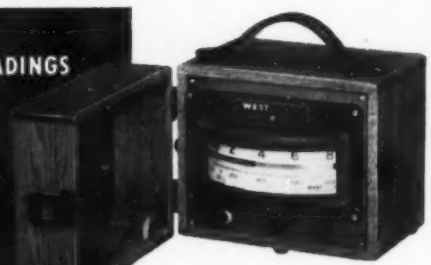

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First of all, what's it all about? What does a fellow like John Jackson do all day? In his own words, "I keep in touch with the executives of many different companies—advising them on the use of their IBM electronic data processing computers. I personally consult with these customers, and analyze their scientific and technical problems for solution by IBM. Occasionally, I'm asked to write papers, and give talks and demonstrations on electronic computing. All in all, it's pretty fascinating . . . something new pops up every day." In other words, John is a full-fledged computing expert, a consultant . . . and a very important person in this age of automation through electronics.

Calling on a customer

Since the IBM laboratories are always devising easier and faster ways to solve the problems of science, government, and industry, an Applied Science Representative can never say he's learned his job and that's the end of it. At least once every two months, he attends seminars to be updated on the latest developments in engineering and operations research.

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with top executives, John helped to map out a computer program that saved the organization over 100 days of pencil-chewing arithmetic. Later, for this same company, John organized the establishment of computer systems for aircraft performance predictions . . . for data reduction of wind tunnel tests . . . and for wing stress analysis. At the same time, he worked with this company's own employees, training them in the use of IBM equipment. John still drops around to see that everything is running smoothly.

Another service that John performs is the constant reappraisal of each customer's IBM operation. Occasionally, a customer may tie himself in knots over a procedural "stickler." Periodically, in fact, John brings IBM customers together . . . just to talk over what's happening in each other's business—how everybody else handled that old bugaboo . . . details.

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With his wife, Katherine, and daughter, Lisa, 20 months, and John, Jr., 6 weeks, he enjoys his suburban Port Washington home. He's happy and he's satisfied. And then, too, John knows a few vital statistics about IBM . . . such as the fact that the Applied Science Division has quadrupled during the past three years, and that in 1956 alone, over 70 promotions were conferred. If ever a future held promise, here is one.

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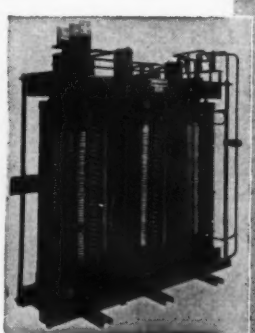

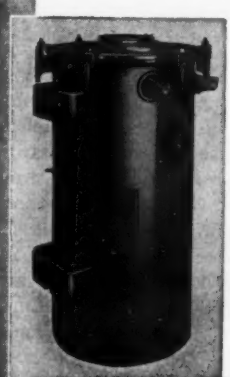

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TECHNOLOGY SHAPES OUR FUTURE

(Concluded from page 314)

and as a friendly companion of art and of moral philosophy. This is a science that is the way it is because man wants it to be that way. It is a natural expression of both his curiosity and his faith."

If we can make science understood in these terms of Dr. Frankel and Dr. Weaver, we can gain much, both for science and for our culture. We can still further break down the antagonism between the domain of science and the domain of the humanities and social sciences with the result that both join together for the furtherance of man's wisdom and understanding.

It is this concept of science as the servant of man, and as basically a humanistic discipline, that helps to strengthen my optimism about progress being real and technology benign.

Two of the special fields in which Americans singularly excel, two of the richest outcroppings of our native resources, are certainly technology and management. We have seen the two of them, each abetting the other, enable American capitalism to confound its detractors and enemies and to adapt itself in a most remarkable way to fulfilling the changing needs of all our people, to make itself not the monopoly of the few but the servant and prodigal provider for all.

It is an inherent characteristic of both technology and professional management that they impose upon our society a relentless requirement for more skill and talent and breadth of understanding – in short, for human quality. As a consequence, we now witness a process of upgrading of skills and talent which can enhance the quality, the sense of the first-rate, of our society, and confound the critics who have predicted that the materialism of the machine can only lead to the standardization and deterioration of human beings.

As technology advances, it generates new requirements for education. It requires not only more engineers and scientists; it provides new opportunities for all our talents and professions for humanists and ministers and social scientists and doctors and lawyers and all the skills of labor. It imposes a relentless requirement for new knowledge and discovery along with greater sensitivity to humane and moral values and a pervasive elevation of our aims and ideals. To use a line of Robert Frost's, "It asks of us a certain height" and this height steadily climbs.

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(*Concluded from page 302*)

science and his efforts in defense of our country and the advancement of mankind." His Indian name is "Man of Big Mind." Dean Harrison jocularly referred to the honor bestowed on him as an "S.O.S." degree signifying "Sage Osage."

The presentation ceremony was solemn and reverent. Chief Pitts was assisted by five members of the tribal council and three other honorary members of the Osage Tribe. The delegation from the Osage Indian Agency in Pawhuska also included Russell G. Fister, superintendent of the agency, and Tom Ferrier, chief of minerals.

Mr. Sherry, who was largely responsible for arranging the conference as a salute to Oklahoma's golden jubilee, was described as "Mr. M.I.T. of Oklahoma" in the award presented to him by Theodore T. Miller, '22, President of the Alumni Association.

Mr. Holway, the recipient of the other award, is one of the world's foremost designers and builders of water systems. Besides designing Tulsa's modern water system and the two dams which supply water to the city, he has designed and helped to build systems for many other cities in the state.

Co-chairmen of the committee responsible for the success of the conference were Walter S. Smith, '30, and Bernard E. Groenewold, '25. They were assisted by subcommittees headed by Scott W. Walker, '40, David A. Bartlett, '39, John G. Burke, '38, Erling O. J. Helland, '40, and Donal K. Holway, '47. Joseph D. Eisler, '32, and R. L. Rahder of the Pan American Petroleum Corporation arranged for astonishingly extensive press, television, and radio coverage.

Among those who traveled far to join the Oklahomans were: Edward J. Hanley, '24, President, Allegheny Ludlum Steel Corporation, Pittsburgh; Horatio L. Bond, '23, Chief Engineer, National Fire Protection Association, Boston; John J. Desmond, Jr., Commissioner of Education, State of Massachusetts; Hugh S. Ferguson, '23, Executive Vice-president, W. R. Grace and Company, New York; Thomas L. Stephenson, 3d, 6–45, Aluminum Company of America, Pittsburgh; John Lawrence, '32, President, Jones Manufacturing Company, Pittsburgh; William H. MacCallum, '24, Vice-president, Modern Talking Picture Service, Los Angeles; and John R. Kirkpatrick, '48, of Chicago, Vice-president, Arthur D. Little, Inc., Cambridge.

Oklahoma City was well represented by a large delegation that included Dean A. McGee of Kerr-McGee Oil Industries, Inc., and James Harlow, Director of the Oklahoma City Frontiers of Science Foundation. Wichita visitors included Fred C. Koch, '22, President of the Wood River Refining Company. Cecil H. Green, '23, President of Texas Instruments, Inc., was among those from Dallas.

While other regional conferences have attracted industrial leaders who were not necessarily Alumni of M.I.T., the Tulsa conference was unusual in the large proportion of non-Technology persons who attended. All in all, it was the type of event that makes friends for M.I.T.

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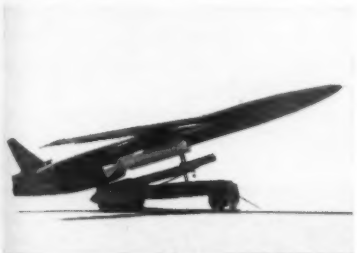
Snark scheduled for Strategic Air Command

(HAWTHORNE, CALIF.) Northrop Aircraft's Snark SM-62, America's first intercontinental guided missile, is now scheduled for delivery to the Strategic Air Command of the U. S. Air Force. It will be placed with operational units to assume an important role in the air defense of the United States.



Powered by a Pratt & Whitney J-57 turbojet engine, and with a 5000-mile range, the Snark cruises at high altitudes with fighter-plane speed. It is designed to deliver a nuclear warhead at supersonic velocity to any target in the world, day or night. A large number of these intercontinental missiles can be launched in quick order in any weather.

With an overall length of 69 feet, wing span of 42 feet, and height of 15 feet, the Snark is easily air-lifted to any site or base with its Northrop-developed mobile launching platform. The Snark has demonstrated its remarkable ability to guide itself successfully over the long-range proving ground in the South Atlantic from Patrick Air Force Base, Cape Canaveral, Florida.

A pioneer for 17 years in the development of supersonic aircraft and missiles, Northrop Aircraft has won distinction for its many achievements in this field. The latest Northrop project is a lightweight supersonic trainer plane, the T-38, that promises to reduce considerably the cost of training Air Force pilots.

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If you are an experienced computing analyst—or if computing and data reduction are new to you but you are a qualified engineer—there is interesting work as well as a bright future for you in Northrop Aircraft's growing Computer Center at Hawthorne, California.

Applied mathematicians and engineers are needed as computing analysts for assignment to Northrop's analogue computing facility, as well as the newly expanded digital electronic computer department which provides unparalleled service in the practical solution of complex engineering problems.

Northrop has many openings on its other projects having to do with jet aircraft and missile design. They include positions for electronics and electro-mechanical engineers and lab technicians. In addition to attractive compensation, Northrop offers benefits unexcelled in the airframe industry as well as helpful cooperation by forefront engineers for your professional advancement.

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If you qualify for any phase of computer research, design or application, we invite you to contact the Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., ORegon 8-9111, Extension 1893, or write to: 1015 East Broadway, Department 4600-BB, Hawthorne, California.

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REGIONAL CONFERENCE — CHICAGO

(Concluded from page 303)

Pietro Belluschi, Dean of M.I.T.'s School of Architecture and Planning, at the afternoon session called for more humanism in architecture – and a more comprehensive view of the total environment as a basis for planning its individual units.

Allen W. Dulles, Director of the U.S. Central Intelligence Agency, concluded the Mid-America Conference at the banquet in the evening with an optimistic report on political and social developments in Russia, and a review of Soviet history since the death of Stalin – as recorded, beginning on page 295.

Among those present for the Mid-America Conference who contributed so much toward its success were:

Louis H. G. Bouscaren, '04, Director, Market Facts Inc., who presided at the afternoon session of the conference;

Theodore T. Miller, '22, President of the Alumni Association, who presented citations of the Association to James M. Barker, '07, a life member of the Corporation who is chairman of the Board, Allstate Insurance Company and who was banquet toastmaster at the conference; and to Robert E. Wilson, '16 (also a life member of the Corporation), chairman of the Board, Standard Oil Company of Indiana, who was prevented by illness from attending but who received a telegram with the conference's best wishes and greetings;

Philip L. Coleman, '23, Partner, Duff and Phelps, who presided at the conference luncheon;

Dwight K. Taylor, '26, Western Division Manager of Connelly, Inc., and President of the M.I.T. Club of Chicago;

Robert C. Gunness, '34, Executive Vice-president, Standard Oil Company of Indiana, who presided at the morning session;

F. Richard Meyer, 3d, '42, Past President of the M.I.T. Club of Chicago, who was chairman of the conference;

Robert C. Meissner, '43, of J. F. Meissner Engineers, Inc., who was co-chairman of the conference;

Dean Joseph C. Boyce, Vice-president, Illinois Institute of Technology;

Theodore V. Houser, a special term member of the M.I.T. Corporation, chairman of the Board, Sears, Roebuck and Company;

Lawrence A. Kimpton, Chancellor, University of Chicago.

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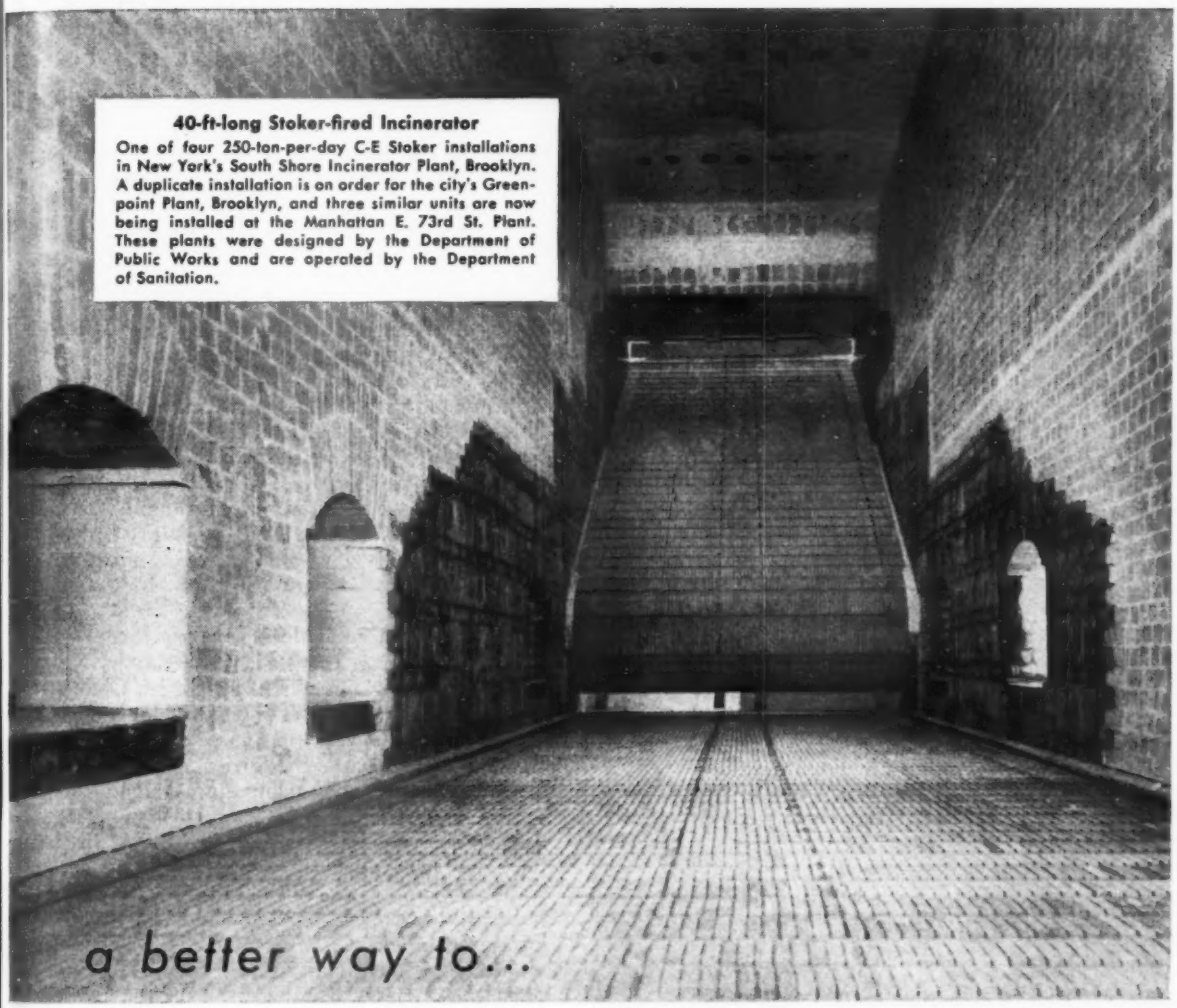

40-ft-long Stoker-fired Incinerator

One of four 250-ton-per-day C-E Stoker installations in New York's South Shore Incinerator Plant, Brooklyn. A duplicate installation is on order for the city's Greenpoint Plant, Brooklyn, and three similar units are now being installed at the Manhattan E. 73rd St. Plant. These plants were designed by the Department of Public Works and are operated by the Department of Sanitation.

GET RID OF REFUSE

REFUSE — its a big problem for cities and for industries, too. Usually, the best way to get rid of it is to burn it. That's what New York City does — using enormous stokers like the two shown in the incinerator furnace above, which can burn nearly two hundred and fifty tons of garbage and all kinds of refuse a day.

Four C-E stoker-fired incinerators like this went to work in the vast New York refuse disposal system two years ago. Since then, seven similar units have been ordered.

These stokers are specially designed to meet a special problem. But stoker units like this can burn mountains of *industrial* wastes, too. Moreover, combined with a waste heat boiler, they can be used to generate steam for space heating or process work.

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EVOLUTION IN COMMUNIST WORLD

(*Continued from page 298*)

tion of thinking youth — their restless desire for real integrity and honesty in their society — must deeply concern a regime which needs their services and shapes its claims to allegiance on an ideology.

The General Crisis of Communism

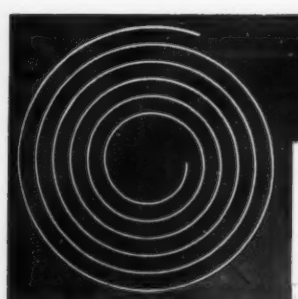
For many years now that ideology has predicted the doom of capitalism — recently with a little less assurance as to the date of Doomsday. The Communist leaders have not, however, given up the dogma that World War I marked the beginning of a new epoch which would witness the general crisis of capitalism. According to all good Communists, this general crisis would embrace many individual crises caused by wars over markets and colonies, by workers' revolutions in protest against economic depressions, and by capitalist greed. These "inner contradictions," the doctrine preached, would inevitably lead to the collapse of capitalism and the triumph of the Communist system.

Today, with a great deal more assurance, we can advance the thesis that it is they, rather than we, who face a general crisis. A Yugoslavian Communist, Milovan Djilas, alerted the world to this crisis of Communism in his famous article of last November. He said this: "Despite the Soviet repression in Hungary, Moscow can only slow down the processes of change; it cannot stop them in the long run. The crisis is not only between the U.S.S.R. and its neighbors, but within the Communist system as such. National Communism is itself a product of the crisis, but it is only a phase in the evolution and withering away of contemporary Communism . . . World Communism now faces stormy days and insurmountable difficulties."

With the flood of self-questioning loosed by the anti-Stalin crusade and by the events in Hungary and Poland, the Soviet system certainly evidences inner contradictions that are harder to cope with than anything now facing the non-Communist world.

The Soviet leaders have been trying for some time now to cover up the cracks in their ideological plaster by talk of a "return to Leninist norms of party life." They tell their people to avoid the "cult of personality" by going back to Lenin for guidance; but is not

(*Continued on page 324*)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EVOLUTION IN COMMUNIST WORLD

(*Continued from page 322*)

this a new "cult of personality"? And who is to say what part of Lenin is to be kept and what rejected? Why should they not follow the advice Lenin gave in May, 1917, that: "If Finland, if Poland, if the Ukraine break away from Russia there is nothing bad about that. What is there bad about it? Anyone who says there is, is a chauvinist. . . . No nation can be free if it oppresses other nations."

The Challenge to the U.S.S.R.

No regime could stand still in the face of events such as those of the past few years. Sooner or later, the challenge facing the U.S.S.R. at home and abroad must be met.

A well-known passage in Toynbee's *Study of History* is relevant to the U.S.S.R. today: "The unanswered challenge can never be disposed of, and is bound to present itself again and again until it either receives some tardy and imperfect answer or else brings about the destruction of the society which has shown itself inveterately incapable of responding to it effectively."

What is the shape of the society which might develop out of the evolutionary forces presently at work in the U.S.S.R. if the Kremlin leaders do not blindly seek to reverse them?

Domestically, the U.S.S.R. would take cognizance of human dignity in its society. Censorship of thought would be eliminated and greater emphasis placed on satisfying the economic wants of the individual. Here it must be noted that the U.S.S.R. has taken a forward step in doing away, at home, with the special tribunals and some excesses of the secret police.

In the foreign field, such a development would require the U.S.S.R. to accept a genuine co-operation with other nations as distinct from the tactical, Leninist idea of a temporary truce. It would have to concede to those lands it has occupied the freedom of political choice. It would have to assume a constructive role in the United Nations.

Of course, such an outcome is not yet in sight. The future is still cloudy, and the possibility of an attempted reversion to a hard line remains.

Nevertheless, the reality of pressures for change is undeniable, and they seem unlikely to diminish with the passing of time. An evolutionary accommodation to these forces may even be more likely than the convulsive developments which the history of the *ancien régime* in France or the Roman Empire might lead one to expect.

Continued Danger

Of course, it would be folly to assume that international communism is on the verge of collapse. It continues to possess and develop increasing physical power; and we face the very real danger that it may bolster up its position in two particularly sensitive areas.

(*Concluded on page 326*)

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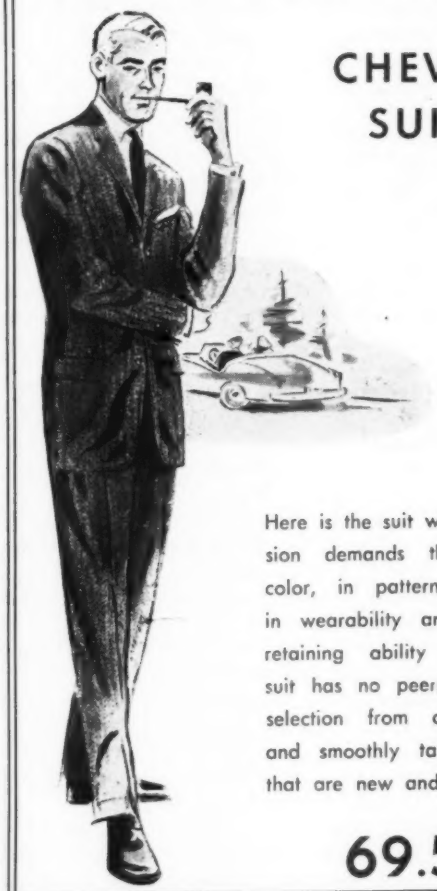

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EVOLUTION IN COMMUNIST WORLD

(*Concluded from page 324*)

The first of these is, of course, the Middle East where a general policy of aid, infiltration, and stirring up troubled waters offers considerable prospects for creating serious mischief.

The second area of danger – which is perhaps not receiving as much public attention as it deserves these days – is the Far East. Communist China, during the past few years, has been posing an ever-increasing threat to many nations in the area which are relatively unsophisticated in the ways of Communist subversion. Within the Communist world, the prestige of Communist China has been relatively enhanced by the fact that its leaders have not been so morally compromised by the revelations about Russia's dictator, Stalin.

Macaulay's Prophecy

While there is no justification for complacency in the Free World, there are some real signs of hope. Sporadic success abroad will not change the basic problems within the U.S.S.R. if we correctly assume that the evolutionary process has started. And even in Communist China, as revolutionary fervor dims, the reaction may come as man's reaching for freedom and human dignity asserts itself.

In a prophetic speech in 1833, Macaulay spoke words which might well be pondered by the leaders of the Communist world as they face the problems that lie before them today. Macaulay was urging his countrymen not to shrink back in fear from the possibility that education and modernization would lead the people of India to seek independence.

"What is that power worth," asked Macaulay, ". . . which we can hold only by violating the most sacred duties, which, as governors, we owe to the governed? We are civilized to little purpose if we grudge to any portion of the human race an equal measure of freedom and civilization. . . . do we think that we can give them knowledge without awakening ambition? . . ."

And Macaulay concludes: "It may be that the public mind of India may expand under our system till it has outgrown that system; that by good government we may educate our subjects into a capacity for better government, that having become instructed in European knowledge, they may at some future age demand European institutions. Whether such a day will ever come I know not. But never will I attempt to avert or retard it. Whenever it comes it will be the proudest day in English history."

When the day of freedom for Russia and the peoples under Soviet rule may come, no one can prophesy. But when it comes, it will be the proudest day in Russian history. If that day is to be hastened, we cannot afford to be timid in asserting profound faith in our democratic institutions, and in acting decisively on that faith. I sincerely believe that the time has come when no reasoning, thinking peoples with freedom of choice can continue to believe that Communism is the wave of the future. The lasting, enduring values are in our free way of life.

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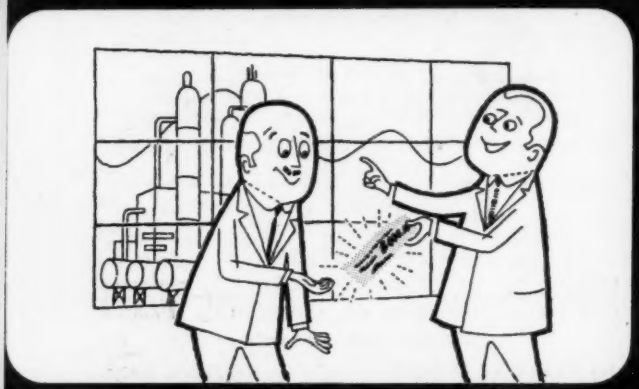
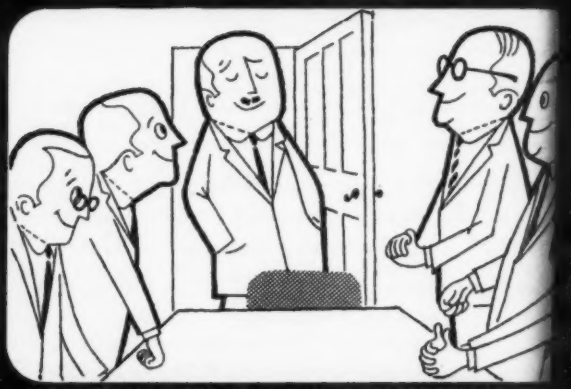
Robert E. Smith '41, Vice President

When Lummus builds your new plant, you select the contract arrangement best suited to your needs. For example . . .

You may decide on a *lump sum* (turnkey) contract, wh final cost can be fixed before work starts.



You may want Lummus to build on a *guaranteed maximum* contract. Any savings are then shared with you on a pre-arranged basis.



Or maybe you prefer a *cost-plus* arrangement. Your a and directors will cheer Lummus' astute purchasing

Want to get on stream fast? A convertible *cost-plus* contract gets work started, can be changed to any other type after job is fully defined.

Whatever arrangement you choose, Lummus experience on-time completion, efficient operation.

Build your new plant on a "tailored" contract

The first money-saving step in building a new plant is to pick an experienced engineering and construction firm. The second is to make sure the contract is tailored to your needs. The Lummus Company will design, engineer and build your new facilities on any of the basic arrangements outlined above. And Lummus' 50 years of experience with more than 800 process plants all over the world, insures on-time completion, a smooth startup, efficient operation. It will pay you to talk over your plans with Lummus.

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To trainmen, the wagging point of light says a lot. And to signal men, the name "Simplex" says a lot, also. Simplex Railroad Signal Cables are famed for their dependability. Engineered to perform equally well in overhead or in-the-ground installations. They defy sunlight, ground acids, alkalies, oil, heat and flame, and their ANHYDREX insulation eliminates damage from water absorption. Easy to install, and color-coded for easy splicing and terminating.

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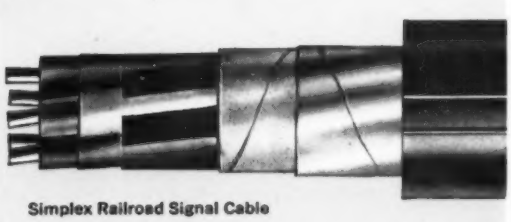

Simplex Railroad Signal Cable

Unit Oscillators

★ High Power Output ★ Simplicity of Operation ★ Wide Frequency Ranges ★ Low Cost

GR Unit Oscillators . . . covering the range from 20c to 7425 Mc . . . provide value per dollar difficult to match anywhere.

The fundamental task of signal generation is performed simply and well by instruments devoid of expensive frills. Sound electrical circuitry, incorporating only the essential features, makes them the equal in quality of any made by General Radio. Mechanical design emphasizes small size, light weight and basic miniaturization — the cabinets are about as small for heat developed within them as good engineering practice will allow.

The G-R UNIT INSTRUMENT concept provides flexibility as no other equipment does. One of the high-frequency Unit Oscillators, plus a Unit Power Supply, serves as an unmodulated general-purpose signal source having high-power output and good shielding. Add an audio fixed-frequency Unit Oscillator, and the assembly becomes a modulated power source. Add an attenuator, crystal rectifier, and a meter, and you have a standard-signal generator. Substitute a different high-frequency oscillator, and the system covers a new frequency range. At low frequencies, the addition of a Unit Amplifier gives more power.

Use of new G-R Sweep Drives adapts these manually-operated oscillators to automatic sweep applications. Accessory G-R attenuators, rectifiers, and modulators all may be used to contribute to the measurement at hand. There is no end to the assemblies and combinations possible — systems are easily extended to meet the requirements of new and different measurement problems with precision and economy.

Unit Oscillator	Frequency Range	Maximum Output/ Open Circuit Volts	Nominal Load Impedance	Additional Features
1210-B RC Oscillator, $165	20 cycles — 0.5 Mc (sine or square waves)	80 mw/7v 40 mw/45v 0-30v, p-p	500Ω 12,500Ω 2,500Ω	Multi-purpose lab signal source — 7v output, flat with a ±1 db to 200 Kc; distortion less than 1.5%.
1214-A Unit Oscillator, $75	400, 1000 cycles (2 fixed frequencies)	200 mw/60v	8000Ω grounded or ungrounded	Inexpensive fixed-frequency oscillator, has built-in power supply.
1211-B Unit Oscillator, $275	0.5–5 Mc 5–50 Mc	2 w 200 mw	50Ω	Compact, well shielded — frequency increments of 0.25% per division.
1213-B Unit Oscillator, $190	50–250 Mc	80 mw	50Ω	Semi-butterfly tuned circuit with no moving contacts.
1208-B Unit Oscillator, $200	65–500 Mc	100–500mw	50Ω	Very wide range in one band; thorough shielding.
1209-B Unit Oscillator, $235	250–920 Mc	200 mw	50Ω	Butterfly circuit avoids uhf tuning difficulties — excellent stability.
1218-A Unit Oscillator, $465	900–2000 Mc	200 mw	50Ω	Audio, pulse, square-wave or frequency modulation from external source.
1220-A Klystron Oscillator $305 without tube	8 Klystrons available 2700 to 7425 Mc range. $49.65 to $107.15	40 mw	50Ω	Compact, low cost microwave source — internal 1-kc square wave modulation; pulse or frequency modulation from external source.
1217-A Unit Pulser, $235	30 c — 100 kc (12 fixed frequencies)	20 v	200Ω positive pulses, 1500Ω negative pulses	Rise time, 0.05 μsec-durations continuously variable 0.2 to 60,000 μs.
1213-C Time/Frequency Calibrator, $195	5 Mc crystal provides 10 kc, 100 kc, 1 Mc, 10 Mc fundamentals and harmonics to 1000 Mc	10-30 v, p-p video output	calib. follower approx. 300Ω	Compact secondary frequency standard — accurate timing source for scope calibration, etc. — stability 1 ppm/°C after 1-hr. warmup.

Converted to Sweep Oscillators by

1750-A Sweep Drive, $460

. . . attaches to knobs, shafts or dials of a variety of equipment for automatic sweeping . . . Speed adjustable from 0.5 to 5 cps; Sweep Arc and Center Frequency also continuously variable . . . Type 1263-A Amplitude Regulating Power Supply, also shown, holds oscillator output constant as frequency is swept; Price, **$280**

907-R and 908-R X-Y Dial Drives, $55 each

. . . for sweeping at slow speeds; ideal for recording of filter characteristics — sweep voltage for oscilloscope or x-y plotter also provided — easily installed; panel knob readily disengages motor for manual operation.

★ Unit Instruments except 1214-A require Unit Power Supplies 1203-A Unit Power Supply, $40 — 1201-A Unit Regulated Power Supply, $85 1202-A Unit Vibrator Power Supply, $125, for operation from 6v or 12v storage battery

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